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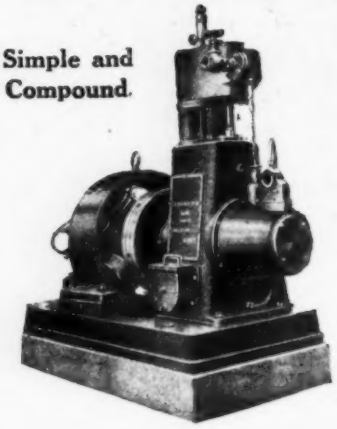

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WORK AND PROSPERITY.

WE have shown, on several occasions recently, that plenty is essential to peace and prosperity; and this view is proclaimed on all sides by everyone who devotes serious thought to the subject. Mr. Clynes has said that plenty is the friend of the worker, scarcity the friend of the profiteer. *The Observer* calls on us all to get ahead with the work that wins, and in this phrase lies the gist of the truths we have endeavoured to put forward, in season and out of season, ever since the cessation of actual hostilities put peace among some of the less remote possibilities of a not too distant future. The debt incurred during the war amounts to the mortgaging of production. Without production there cannot be plenty, and production involves work, hard work, and continuous work. We have had our excitement, and now we have got to pay for it. We can only pay for it by work. Production has been one of the catchwords of the day, and it is time it was realised that plenty will be reached, permanent prosperity attained, only when everybody awakens to the fact that it is his or her duty to get on with the job immediately in hand.

This duty, according to our own impression, has been best realised by Belgium, of the allied nations, less well by Great Britain, and hardly at all by France. We expect it is realised in Germany more keenly than in Belgium, and it is from knowledge of the German temperament, not from ignorant fear, that we repeat our former warning that danger to British prosperity is more to be apprehended from impoverished Germany than from prosperous America. Adversity is a great producer of unity of effort. This was proved during the war, so far as the British nation was concerned, and adversity is unifying Germany now. Unless there is a very great increase in the co-operative spirit of which everyone was talking only yesterday—there are already ominous signs of weariness of the topic on both sides—unless this spirit manifests itself more certainly, the British Empire, having emerged victorious from the war, will be in a fair way to lose the peace.

But, it may be said, what is the use of telling everyone to work hard when a million workers are unemployed? Unemployment, as we said in a recent article, will be remedied when there is more business. Slackness of business is due to several causes, prominent among which are the restriction of credit and the crushing incidence of taxation upon industry.

The restriction of credit by the banks is an early step in the policy of monetary deflation to which the Government is committed. The Right Hon. Reginald McKenna, whose appointment to the important position of chairman of the London Joint City & Midland Bank, Ltd., and statesmanlike speeches in that capacity, may

well make many people realise what a Chancellor of the Exchequer was here despised and rejected, threw a good deal of much-needed light on the financial situation in his address to the shareholders of that bank on January 28th last. The first step in inflation is taken when a bank makes a loan; the first step in deflation, therefore, is taken when that loan is redeemed, either willingly or under pressure. Deflation reduces prices, because purchasing power is diminished. Here it is necessary to discriminate carefully between the two meanings that can be attached to the expression "purchasing power." The purchasing power of the sovereign has diminished, and on the whole that is a bad thing, although, so far as the National Debt is concerned, there are redeeming features about the phenomenon. Purchasing power, in the sense in which Mr. McKenna used the expression, is created by the issue of loans, or paper money, in excess of gold reserves, and in the absence of commodities, the result is a general forcing-up of the number of paper tokens charged for such commodities as are obtainable. When credit is withdrawn, prices fall; but here care must be taken. They fall for the reason that the proportion of commodities to the purchasing power in existence increases; but they may fall, and are falling now, as a result of the compulsory liquidation of assets, the forced throwing upon the market of stocks of goods which the holder must turn into money, no matter at what loss, in order to live. This second fall operates to bring about scarcity, and if it lasts long enough, is bound to produce another rise in prices, so that the last state will be worse than the first.

For the reason that we are all accustomed to think in pounds, shillings, and pence, it is generally regarded as undesirable to obtain fewer pounds for a thing than were originally given for it. Hence a period of good trade is a period of rising prices. The falling prices, said to have brought about already a reduction of some 12 or 15 points in the cost of living, will not and cannot last beyond the time required for the realisation of stocks, unless more commodities are produced and made available, and that, too, without increase in the cost of production. In order to get to the beginning of a period of prosperity, prices will have to fall very considerably.

The question is one that is perfectly familiar to electrical engineers. Up to the point where the load factor, whether of a supply station or a factory, is 100 per cent. the total cost of production can always be reduced, because the standing charges are distributed over a greater number of units or manufactured articles. It is often thought that when this point is reached, further economies are impossible, because extensions are involved, and more capital has to be expended. But it must not be forgotten that if such extensions are carried out as economically as possible, the standing charges may not only not be increased, but may actually be further reduced, by the averaging process; and not only so, but the economy of operation of the new plant, being usually superior to that of the old, will tend to lower the running costs. Electrical engineers have learned that when an undertaking is threatened with a loss, the best way to avoid it, and to change the prospects from dull to bright, is to reduce the price per unit. The famous Bermondsey clause, by which the gas supply authorities endeavoured to make a loss on the electricity undertaking involve a compulsory increase in the price per unit, was not, of course, dictated by solicitude for the welfare of the electricity supply. It was directly against the interests of electricity, and was calculated, and intended, to play into the hands of the gas supply.

When a business is not making a profit, it is because of two reasons, which may operate together or separately. Either it is spending too much, or it is earning too little—generally both are true. If it is spending too much, economy must be practised. If it is earning too little—what then? Increase the fares at the holiday season, force up the telephone charges without discussion or notice? That is the Government way, and it is, in our opinion, a very bad way. Anyhow, no business firm could adopt such autocratic methods and expect to remain in business.

We venture to suggest that a better policy would be to encourage traffic, to endeavour to spread the load and increase the load factor. We see signs of an intelligent policy of this nature in cheaper evening telephone calls, and cheaper midday rides on the London tramcars and omnibuses. But week-end telegrams are dearer than ordinary telegrams; there are few excursion facilities, and those there are, are apparently grudgingly granted; the telephone service is not only dear and to be dearer, but it is inefficient to boot.

We constantly urge production—work and production. It is absolutely necessary to get the most out of the machinery available to us. It may be objected that none but standard goods can be produced except against definite orders, and what are we to do about non-standard apparatus, such as many classes of electrical goods? Here we are faced with the problem of selling, and we shall return to this in another article.

Compensation for Officials.

We hear that the Association of Staff Officers in Electricity Supply is keeping a sharp eye on the various schemes that are being formulated for the "electricity areas" delimited by the Commissioners. This Association, it will be remembered, took energetic action when the Electricity (Supply) Act was before Parliament. Section 16 covers compensation for deprivation of employment, but it does not define the exact compensation; it is, in general, such as a referee or board of referees may award. There is a proviso that such compensation shall, in the case of an officer employed at an annual salary, be based on, but not exceed, that possible in the Civil Service at the date of the local Government Act, 1888. There is much virtue in the definition "officer employed on an annual salary." The definition narrows down if interpreted very literally. We understand, however, that the Association is taking steps to secure, if possible, that a uniform basis shall be embodied in the administrative or financial section of each scheme, so as to make the compensation perfectly definite, and avoid quibbles and contention afterwards, which is very wise on the part of the Association. The Civil Service scale is its desideratum. The Association is evidently going to take no chances.

Directors are left out in the cold in this deal, no mention of them being made in Sec. 16. As a matter of fact, when the Act was before the House there was just a sporting chance that they would be included. One worthy member had tabled on the order paper an amendment to include directors in the share-out—but waiting his turn to move his amendment, the member lost his chance. The opportunity was lost in one of those sudden merry-go-rounds which sometimes happen in the Committee Room when clauses are being reshuffled. "And so the poor dog had none!"

What Constitutes Intimidation?

During recent years employers have become so accustomed to acceding to the demands of trade union officials that the necessity of solving the question: Has there been intimidation? has not often arisen. But the question does sometimes fall for decision in the courts. The case of *White v. Riley*, which is reported in the January number of the *Law Reports*, is a useful illustration. It was there held that the mere statement to an employer by a number of workmen that they will not work with another workman, and that if that workman is retained in the employer's

service they will strike, even where they have knowledge that he cannot dispense with their services, does not of itself constitute an unlawful threat, and is, therefore, not of itself actionable. The facts of the case were that the plaintiff was a member of the Workers' Union. Having obtained work with a firm of curriers, he was asked to join the Curriers' Union, which he refused to do. The defendant was a prominent member of that union, who signed a letter on behalf of the other men in the shop which was addressed to the employers. The letter stated: "We hereby give you notice that we shall cease work on Friday next unless E. White either joins our society or leaves your employment." In consequence of this the employers gave the plaintiff a week's notice. He thereupon brought suit against the members of the union who had been employed with him, alleging that by conspiracy, threats, intimidation, and coercion they had caused his dismissal from his employment, and procured a breach by his employers of their contract with him. Mr. Justice Astbury found for the plaintiff, but his judgment was reversed by the Court of Appeal. The Master of the Rolls, in the course of his judgment, said: "It is clear that if a set of men object to work with another man or another set of men they have a perfect right to say that they will not work with him any longer, and, more than that, they have a perfect right to tell their employer what they are going to do. It is sometimes expressed by saying that they have a right to give him a warning, but they have not a right to threaten. Of course, both of those words are difficult to define, and I prefer to say that they have the right to make the statement to him that they are going to do it, and that whatever epithet or substantive you may apply to it, if they do not go beyond that there is no cause of action."

Industrial Efficiency.

The terms "industrial fatigue" and "industrial psychology" have become fairly familiar during the past few years in relation to the attempts that have been made in this country, following on the more detailed work that has been done in America, to diagnose industrial fatigue, and, in short, increase output. There are signs, however, that the temperament of the British worker (by which we do not necessarily mean the manual worker) does not lend itself kindly to the processes of self-analysis which seem to have found so much favour in America, and it is not surprising, therefore, that there is an inclination on the part of the British school of industrial psychologists to abandon the rather narrower scope of their investigations into industrial fatigue, and to adopt a broader and more comprehensive outlook by extending their studies and embracing within them the whole subject of industrial efficiency, thereby dropping the two terms mentioned above, which, together with another, namely, "scientific management," have not altogether impressed themselves favourably in this country, outside, of course, those who wish to impose the results of them on industry.

In spite of the volumes which have been written upon the subject, it is now admitted that there is not, and, we venture to think, never will be, a satisfactory definition or a satisfactory test of fatigue, for, as Dr. C. S. Myers, F.R.S., Director of the Psychological Laboratory at the University of Cambridge, recently pointed out, a mechanical dead level of factory output throughout the day, which seems to have been the aim of a good many psychological students, is surely unrealisable, having regard to the many human factors that must come into play in relation to a man's work, no matter whether it be manual or mental. If this limitation is accepted, and we think that it must be, greater progress will be made in the application of some of the principles which have come to us from the United States by a closer attention to the general question of industrial efficiency, and, looked at in this light, it can be at once said that we in Great Britain do not compare so unfavourably with America in this respect as some would have us believe. It is a curious thing that in all discussions of this kind almost sole reference is made to what has been done in America, and it is not surprising that this is just a little apt to get on the nerves of those to whom these discussions are addressed. As a matter of fact, a great deal of good, solid work has been done in the various industries in this country with regard to improving industrial efficiency, and at the same time lessening the strain on the workers and improving their conditions generally, although not much has been said about it, because, perhaps, dealt with in this general way it does not lend itself to that picturesque presentation to the hearer that some of these specialised inquiries carried out elsewhere have allowed of.

One or two similar inquiries were carried out in this country under war conditions, but even the Industrial Research Board itself now admits that they have little bearing upon the commercial aspect as it presents itself in peace time. Things have, to some extent, crystallised themselves by the formation of the National Institute of Industrial Psychology, which has been established by voluntary support, and provides a body to which employers of labour can now turn for assistance and guidance as regards their own particular problems, leaving it to the Industrial Fatigue Research Board to carry out its inquiries on behalf of the Government for industries as a whole. Many employers of labour, and most employés, will welcome this change of attitude, for it is another instance of the folly of bringing from other countries ready-made theories, and endeavouring to adapt them to practical conditions, elsewhere, which are very far from fitting those theories. Industrial efficiency is a sphere of study and investigation which is bound to appeal to everybody, and the employé's co-operation can be the more readily obtained when he realises that the whole of his industrial conditions are under consideration, rather than the application of some particular theory which it does not take a very keen intellect to imagine, rightly or wrongly, has one object, *i.e.*, greater output, without any broad consideration of the human side of the problem.

The Severn Barrage Scheme.

The discussion at Birmingham in which members of the Institutions of Civil, Mechanical, and Electrical Engineers took part was not only interesting in itself, but also marks a new departure which may lead to very useful results. Joint meetings, it is true, are not novel, but a conference of the three leading institutions on an engineering project which is still in the lap of the future is a welcome innovation.

It was pointed out that the cost of the scheme under existing conditions would be prohibitive; on the other hand, Mr. Addenbrooke showed that in any event it would not be possible to commence work on the site for at least four years, and that the type of plant to be employed need not be settled for two years longer. Hence there is ample time for consideration of the details, and by that time the cost of labour and materials may, and probably will, have been reduced to a more practicable level.

Mr. Chattock held that by adopting the Tlury system the cost could be greatly reduced, and on this basis Mr. N. Rosher estimated that to transmit 100,000 kW to Birmingham would require overhead lines costing one million sterling; assuming the cost at the Severn to be ½d. per unit, the selling price in Birmingham could be 0.8d. per unit. There was, however, plenty of opposition to the scheme from speakers of considerable weight. We think that the discussion was a fruitful one; it will be reported in our pages at an early date.

THE ELECTRICITY (SUPPLY) (No. 2) BILL, 1920.

By A LEGAL CONTRIBUTOR.

The Electricity (Supply) Bill (Bill No. 67 of 1920) having been dropped, a new Bill (No. 263) has been introduced to take its place. The first Bill was said to have reproduced "subject to one or two small amendments, the provisions of last year's Bill as passed by the House of Commons which were struck out by the House of Lords," but the "striker out" has also been at work on Bill No. 263, from which some very important clauses have been excluded.

The provisions relating to the establishment of district electricity boards, together with certain important clauses referring to the vesting of generating stations and main transmission lines by those boards are all deleted, but notwithstanding these and other changes, the legislation now proposed involves questions of far-reaching importance to those who are concerned with the supply of electricity. It is proposed to refer to some of these in the hope that Parliament may realise their importance to the industry. In a recent article on "The Jurisdiction of the Electricity Commissioners,"* the present writer was dealing only with the Act of 1919 which was and is *un fait accompli*. The following notes, which refer to a mere Bill which may still be amended or even withdrawn, may, therefore, serve a more practical purpose in drawing attention to some points which are only to be discovered by a very careful scrutiny of the language of the proposed measure.

Clause 1 empowers a joint electricity authority to borrow money: (*a*) for the payment of the purchase price of any generating station or main transmission line transferred to, acquired by, or vested in a joint electricity authority under the Act of 1919, or of any undertaking or part of an undertaking acquired by the authority under that Act; (*b*) for the purpose of any other payment or of any permanent work or other thing which the authority is authorised to execute or do, the cost of which ought, in the opinion of the Commissioners, to be spread over a term of years; (*c*) during the first three years after the establishment of the authority for the purpose of providing working capital.

All money so borrowed may be charged on the undertaking and the resources of the joint authority or on any specific property forming part of the undertaking. It is to be repaid within such period as the Commissioners may determine. The annual provision required to be made by a joint electricity authority or by a local authority for the repayment of money borrowed for the purposes of the Electricity Supply Acts may be suspended whilst the expenditure out of such moneys remains unremunerative for a period of not more than five years.

When the duties and powers of a joint authority under the Act of 1919 are considered, the importance of its being able to borrow money will be realised.

The *duties* of a joint authority are: —

1. To provide or secure the provision of a cheap and abundant supply of electricity (S. 8 (1)).

2. When so *ordered* by the Commissioners, to supply electricity in such areas and on such terms and conditions as may be specified (S. 12 (3)).

3. To furnish accounts, statistics, and returns to the Electricity Commissioners.

4. To establish a fund into which all its receipts are carried, and out of which all payments by the authority shall be made (S. 28 (1)).

Joint authorities also have certain powers, of which the following can be exercised without the consent of the Electricity Commissioners:—

(*a*) The supply of electricity within their districts (S. 12).

(*b*) The right to obtain wayleaves (S. 22 (1)).

(*c*) The right (where authorised by order or special Act to supply electricity) to repair, maintain, or remove electric lines and fittings (S. 23 (1)).

(*d*) The right where so authorised by order or special Act to manufacture and sell electric lines and fittings (S. 23 (1)).

The following powers are exercisable by a joint authority with the consent of the Commissioners:—

(*a*) Purchase (by agreement with the owners) of any generating station or main transmission line (S. 9).

(*b*) The right of compulsory purchase of an undertaking which is at present vested in a local authority (S. 13 (2)).

(*c*) The right to purchase the whole or any part of the undertaking of any authorised undertakers by agreement (S. 13 (4)). Incidentally it may be observed that the right so to sell is by this Act expressly conferred upon all authorised undertakers.

(*d*) To enter into agreements for the use of water power, waste heat, or other form of energy (S. 15 (2)).

(*e*) The right to erect, maintain, alter, and renew any by-product plant (S. 16 (4)).

(*f*) To subscribe to associations (S. 30).

Having regard to the fact that money will be required for exercising the above powers and carrying out the above duties, it seems that the Act of 1919 may become to a large extent a dead letter if the financial provisions of the new Bill of 1920 are not retained.

Some questions of a practical rather than a legal nature appear to arise upon this proposal to grant extensive borrowing powers to these new bodies. What effect will the Bill—even if it only remains a Bill—have upon existing authorities which, in circumstances of extraordinary financial difficulty, are now endeavouring to supply the public with electricity? Suppose that *they* want new capital, will the fact that other bodies, their potential rivals, may borrow money also help them to raise it? Were the financial world all agog to supply existing companies with fresh capital to build new stations or lay new mains the present might be an opportune time to enable the joint authorities to enter the money market as borrowers; but in the existing state of affairs, the policy of enabling any new "local authority" to borrow money appears to be highly inexpedient.

Clause 3 enables the Commissioners to authorise a joint authority to issue stock bearing interest at such rate as the authority with the consent of the Commissioners may determine.

Clause 4, which enables undertakers to give financial assistance to a joint authority, rather suggests that in the view of those responsible for the promotion of the Bill, a joint authority may have some difficulty in raising money. It provides that authorised undertakers in the area, local authorities, and other bodies or persons who receive or intend to receive a supply from the joint electricity authority may lend money to the joint authority, subscribe for any securities issued by that body, and guarantee or join in guaranteeing the payment of interest on any money borrowed by the authority. If a local authority advances money for any of these purposes the amount so advanced is not to be reckoned as part of the total debt of the Council for the purpose of any limitation on borrowing.

Clause 5 makes further provision for the expenses of the Electricity Commissioners. S. 29 of the Act of 1919 provided, in effect, that the expenses of the Commissioners were to be paid by "the several joint electricity authorities and authorised undertakers within the United Kingdom in proportion to the number of units of electricity generated by or on behalf of those authorities and undertakers respectively in the pre-

* Elec. Rev., Dec. 10th, 1920, p. 646.

ceding year." The new Bill provides that where an undertaker obtains a supply from any source other than the joint electricity authority or an authorised undertaker the number of units of electricity so obtained by such authorised undertaker shall be deemed to have been generated by that authorised undertaker. It seems from this that undertakers who take a supply in bulk from an authorised distributor or a power company will not be liable to the levy. Those liable to the levy must make a return to the Commissioners of the number of units generated or obtained by them. If no such return is made, the Commissioners may make an apportionment based on estimates, and the apportionment will be conclusive.

Perhaps the most remarkable clause in this Bill is that which specifies the powers exercisable by the Electricity Commissioners when authorised undertakers are unable or unwilling to give facilities. The clause in question (Clause 8) (which was Clause 17 in the former Bill) provides that on the application of any joint authority, the Commissioners may, after hearing the parties interested, by order require any authorised undertakers to give such reasonable facilities for the supply of electricity within their area of supply as may be specified in the order, including the provision of new works, and if any authorised undertakers are unable or unwilling to comply with any such order, "the Minister of Transport, on the representation of the Commissioners, shall have power, notwithstanding anything in the principal Act or this Act or in any order or special Act, either:—

(*a*) To order that the undertaking of the authorised undertakers, or any part thereof, shall be transferred to the joint electricity authority upon the terms prescribed by Section 2 of the Electric Lighting Act, 1888; or

(*b*) To confer on the joint electricity authority power to supply electricity within the area of supply of such authorised undertakers or any part thereof."

Certain observations upon this very important clause suggest themselves. In the first place, the Commissioners can only be called upon to act by a joint electricity authority if and when that body is called into being. The Commissioners cannot act *mero motu*. The clause, therefore, can only affect a particular undertaker after a joint authority has been formed in the district.

Again, while it is difficult to imagine the Commissioners listening to any complaint by a joint authority unless they are satisfied that the joint authority is ready and willing to step in and make good the defect itself, there is nothing to compel the Commissioners to defer the hearing of an application. "Reasonable facilities" are not defined in the Bill or in the Act of 1919. It is conceived that even if the undertakers could show that they were unable to grant a supply, either because the Commissioners had refused to allow them to erect a generating station, or because owing to high working costs and the smallness of their authorised charges they were unable to provide electricity on a commercial basis, the Commissioners would still have power to make a requirement. It is presumed that the phrase "after hearing the parties interested" involves that the Commissioners before making a requirement shall hold an inquiry pursuant to Sec. 33 of the Act of 1919.

The Commissioners having made a "requirement," and the undertakers having expressed themselves "unable or unwilling" to comply with it, the Minister of Transport may do one of two things. He may order that the undertaking shall be taken over by the joint authority on "compulsory purchase" terms, or he may give the joint authority power to supply in the area.

There is nothing in the Bill to show what steps the Minister shall take before making such an order. It is not, apparently, like a special order within the meaning of Sec. 35 of the Act of 1919, which cannot be confirmed unless an inquiry is held by an independent person appointed by the Minister. Yet it is inconceivable that the Minister would make an order depriving statutory undertakers of their statutory rights, or which, by letting a joint authority in to compete, would reduce those statutory rights to a nullity, without an independent inquiry. He might accept a ruling of the Commissioners that their requirement was proper in justice and in reason; but there is grave reason to doubt whether the undertakers would always so accept it.

There is another point about this clause which undertakers in general and power companies in particular should be careful to note. It takes away a privilege, or at any rate a seeming privilege, conferred by the Act of 1919. Observe that the Minister may exercise his power "*notwithstanding anything in the principal Act.*"

Turning to the Act of 1919 it will be found that Sec. 12 (1) (*b*) provides that a joint authority may not supply power in any part of the area of a power company without the consent of the company, which consent is not to be unreasonably withheld. If the Bill now before Parliament becomes law, the fact that the power company withholds consent is of no consequence, provided the Commissioners have made a requirement with which the company is unable or unwilling to comply. It is true, of course, that if a power company withholds consent, Sec. 12 (1) of the Act of 1919 allows the joint authority to appeal to the Commissioners, and the Minister of Transport may in certain circumstances dispense with consent. Thus they may dispense with consent if consent is unreasonably refused or withheld, and the consent shall be deemed to be unreasonably refused or withheld if the company is not willing and in a position to give the requisite supply upon reasonable terms and within a reasonable time, and in considering what are reasonable terms and what is a reasonable time the Minister shall, amongst other things, have regard to the terms upon which and the time within which the joint electricity authority and the power company are respectively willing and able to give the supply.

It is obvious that while this provision remains in force, those responsible for the management of a power company who are manfully endeavouring to carry out their statutory duties are in a large measure protected. They cannot be required to do what is unreasonable—*e.g.*, to supply energy at 1d. a unit which costs 2d. a unit to produce; nor (it is submitted) can the question whether their refusal is unreasonable or not be entertained unless there is a joint electricity authority able and willing to give a supply within a specified time. As soon, however, as the Bill of 1920 becomes law (if it ever does) the question of reasonable facilities will fall to be decided not by the Minister but by the Commissioners, who may, if so advised, pay no attention to the fact that the joint authority is neither ready nor willing to step in and do the work. This, of course, is to put an extreme case, and to make a very unlikely supposition; but Acts of Parliament—and still better Bills before Parliament—are best criticised in the light of extreme cases. Moreover, it is to be borne in mind that (as already indicated) the joint authority is to supply electricity in such areas and on such terms and conditions as may be specified (see S. 12 (3) of the Act of 1919). The Commissioners would certainly have power, if they thought fit, to exercise it and to authorise the joint authority to supply on terms much more favourable than those conferred by Act of Parliament upon the unfortunate power company.

New Zealand Public Works.—The Department of Overseas Trade has received from H.M. Trade Commissioner in New Zealand (Mr. R. W. Dalton) a copy of the Annual Statement of the Minister of Public Works for the year 1920. The statement, which embodies the report of the chief electrical engineer, contains results of the working of existing hydro-electric installations and information concerning progress on the Government's hydro-electric schemes in North Island, as well as particulars concerning the work of electric power boards which have been set up. The statement deals also with railway and harbour works as well as tramways and irrigation, and may be examined by interested United Kingdom firms on application to the Inquiry Room of the Department of Overseas Trade, 35, Old Queen Street, S.W. 1.

THE EFFICIENCY EXHIBITION.

A period of trade depression and low output might, at first thought, be characterised as an inopportune time at which to hold an exhibition. Nevertheless, a slack time offers many opportunities to those possessing foresight and imagination for reorganisation with a view to business improvement, and to this end the Efficiency Exhibition at Olympia, which has been organised by the *Daily Mail* [Associated Newspapers, Ltd.], should be of some assistance. Its scope may be gauged from the fact that an attempt has been made to cover scientific, industrial, commercial, civic, national, and personal interests, the aim of the organisers being to direct the light of publicity on to ideas, methods, and devices which are calculated to conserve time, energy, and money, and to increase the results obtained by means of human and mechanical energy by the elimination of waste in its broadest sense.

The Exhibition, which remains open until the 26th inst., was opened in a somewhat unconventional manner on Thursday last week by the Right Hon. Sir Robert Horne, President of the Board of Trade. Standing on the platform of the Marconi Co., Sir Robert spoke into a wireless telephone receiver, and his words were conveyed to the far end of the hall and echoed back by means of a combination of wireless apparatus and the "Stentorphone," so that they were heard plainly by all. After the opening ceremony, Sir Robert and the guests proceeded to inspect some of the 200 stands, of which about two dozen are of more or less electrical interest, on which the exhibits are demonstrated. Displays have been arranged by the Ministries of Labour and Health, the Overseas Trade Department, the Federation of British Industries, the Industrial League and Council, and a number of universities, hospitals, technical colleges, and associations.

The programme of conferences which have been arranged to take place at Olympia during the run of the Exhibition covers a variety of interests, and amongst the subjects to be discussed the following are to be found:—Commercial education, fatigue elimination, traffic control, roads, management, co-operation, production and unemployment, fluorescence and ultra-violet light, X-rays and their uses, and radium and its rays. A conference on electric power in industry, arranged by the Electrical Development Association and presided over by Mr. C. H. Wordingham, C.B.E., was to be opened this morning by Mr. J. C. Wigham, and in addition, a number of important technical associations are to hold receptions on various dates, that of the Electrical Development Association having been held yesterday afternoon. In order to encourage attendance at the Exhibition, the *Daily Mail* has offered four four-years' external scholarships, each of the total value of £250, to British-born students, men or women, who are engaged, or about to be engaged, in whole-time business or industrial employment. The scholarships have been arranged with the authorities of the University of London, who will undertake the administrative work in connection with them, and the degree for which successful candidates will prepare is that of Bachelor of Commerce.

One of the most important exhibits is that illustrating the work of the Ministry of Labour's Industrial Training Department, which is responsible for the intensive training of ex-Service men in skilled trades, and the whole of the Olympia annexe is devoted to showing how ex-soldiers and sailors are quickly trained, and to working exhibits, representing some 48 different trades, from the various schools. The whole of the fittings of the 39 stands in the annexe, together with the decorations and notices, have been made and fitted up by disabled ex-Service men undergoing training. An electrical stand is always attractive, and on the one in this section many modern appliances are on view, such as examples of electric irons, armatures, radiators, switches, signs and circuit-breakers. Men at work on jointing, winding, &c., can also be seen.

Briefly outlined, the training system is this:—The disabled man is interviewed and allocated to a congenial and suitable trade in which his disabilities will prove no, or as small a handicap as possible. Then, for a period of from six to twelve months on an average he is trained in one of the Government Instructional Factories, afterwards being transferred to a private workshop for a further training period which varies according to his trade. During this latter period of improvership the employer is asked to pay a learner's wage. The training is designed to give the man a practical knowledge of the processes he will be required to undertake in an ordinary workshop, but supplemented by demonstrations in essential theory, and the atmosphere of the Institution in such that the man's transition from the school to the factory is as frictionless as possible. The intensive system of training considerably reduces the time necessary to train a craftsman, but it cannot make private workshop experience superfluous, and it is in this respect that employers can help. The appeal of Dr. J. T. Macnamara, Minister of Labour, to the public, and in particular to all employers to visit the Exhibition, see what has been done, and then give them a helping hand, should meet with an immediate response; 36,000 men have been trained, 25,000 are receiving their training, and there is a waiting list of 16,000 names. We owe these men not only admiration, but also gratitude, and our debt will not be paid until a place such as they deserve has been found for them in the national industry.

In one respect the exhibits of the Middlesex Hospital Research Departments may be regarded as an integral portion of the hospital; the tests being carried out on the stand are identical with those used to aid diagnosis and indicate treatment in practice, they represent part of the hospital's daily routine. In another respect the methods of research as employed in the advancement of medicine and in teaching students are represented. Research is of many kinds and needs special apparatus; some of this is demonstrated, including a set to illustrate the evolution of apparatus used in the examination of the heart in living subjects, beginning with a simple roll of paper, and ending with the complex electro-cardiograph which has been lent by the Cambridge and Paul Instrument Co. A complete outfit for the employment of X-rays in diagnosis and research has been lent by Messrs. Watson & Sons (Electro-Medical), Ltd., and a selection of X-ray photographs and negatives is also on view. Messrs. Schall & Son have lent a viewing box for examining X-ray negatives, and the Cox-Cavendish Electrical Co., Ltd., a 1921 model of a vertical stand for screening and radiography in an upright position. For the examination of the chest or alimentary tract the radiographer has to be able to make a fluoroscopic examination, and then to be able to take a radiograph immediately afterwards; to effect this safely and conveniently is the function of the apparatus. For the protection of the operator the tube is enclosed in a large box covered with 2 mm. of lead sheet, and a second line of protection is provided by means of a large lead-lined screen between the patient and the operator. All controls are on the front of the stand, and the inward movement of the screen and plate holder is unique. The indicator on the front of the stand automatically registers the tube to plate distance, and both 6 and 10 cm. stereoscopic stops are provided; the freedom of the moving system depends upon the use of ball and roller bearings. Finally, the action of radium rays on germinating beans comprises another of the numerous interesting demonstrations on this stand, and it will be noted that the result is to check the growth.

Messrs. Sheringham Daylight, Ltd., claim that accurate artificial daylight can be obtained from ordinary electric lamps by the addition of the "Sheringham daylight shade" and duplicate-

Fig. 1.—Sheringham Daylight Table Lamp.

coloured objects shown on the stand, and illuminated by means of the two kinds of light, demonstrate the truth of the claims made for the invention. Shades of various types are now being manufactured and used in this country, and attention is directed to the

new table lamp type illustrated in fig. 1; this lamp is 30 in. high, the diameter of the shade being 14 in., and the lamp used should be a 150-watt gasfilled one; the fitting is made of polished aluminium.

Messrs. Scholey & Co., Ltd., exhibit a variety of fractional horse-power electric motors for every domestic and industrial purpose, in sizes of from 1/50 h.p. upwards of the series-wound "Universal" self-cooling type. "Kutmore" portable electric drills possess original features, and the "Croydon Premier Handelek" electric suction cleaner has been specially designed for industrial work where the domestic pattern would not be suitable. The

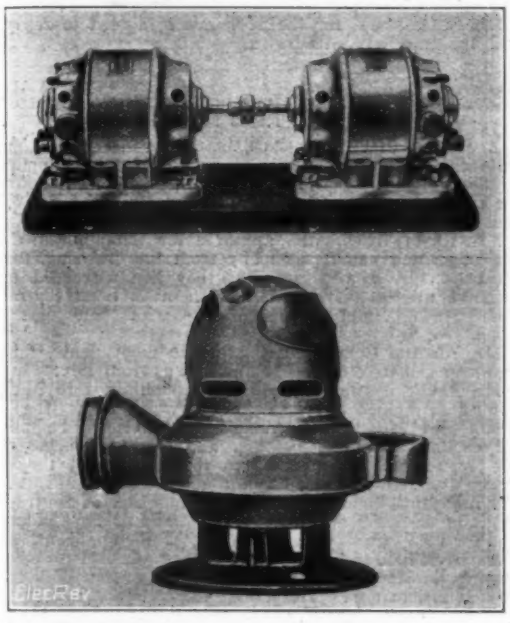


Fig. 2.—Scholeymotor Battery-Charging Set.
Fig. 3.—Scholey Blower.

popular British-made "Scholeymotor" has been fully described in our columns; fig. 2 shows the machine adapted as a charging set for motor garages, medical purposes, &c., while fig. 3 shows an electric blower which has a wide range of usefulness in forge and factory. *(To be continued.)*

THE MAGNETIC FIELD.

By A. G. WARREN, B.Sc., A.M.I.E.E.
(Professor of Electrical Engineering, University of Hong-Kong.)

The energy of an electrostatic field is usually considered as being due to some form of stress in the ether. The magnitude and distribution of the energy is expressed by the relation $w = \lambda F^2/8\pi$, where F is the intensity of the electric force, λ the dielectric constant, and w the energy per unit volume. It is not intended to question seriously this view of the situation; it probably represents accurately the facts as already known; at least it is a convenient working hypothesis and, with our modern catholicity of view, it serves whatever one's beliefs may be about the ether in which the energy is supposed to be resident.

When an electric field is set in motion, forces of another nature, namely magnetic forces, are experienced. The fundamental facts of both electric and magnetic forces were known long before the interconnection between them was realised; magnetism and electrostatics grew up as two strangely parallel, but different sciences. As such they remain largely to-day, despite early suggestions that magnetic phenomena might be electric in their origin. The magnetic field is treated in a manner very similar to the electric field, the energy stored in it is expressed in an exactly similar way ($w = \mu H^2/8\pi$), almost without question regarding the validity of the conception underlying this mode of representation.

The alternative method is to regard the electric field as capable of possessing, like matter, both potential and kinetic energy. To the retention of the terms "magnetic field" and "energy of the magnetic field" as convenient expressions in a mental "shorthand," no objection can be raised, but until it has been shown that a magnetic field can exist independently of a moving electric field, its assumption as a separate entity is unphilosophic and violates the fundamental principles of scientific method.

The unscientific process of multiplying existences beyond what are really necessary for the description of phenomena is, perhaps, inevitable while a science is still in the empirical stage. But with a growth of knowledge, "Occam's razor" must be ruthlessly applied in cutting away all redundant conceptions which have no further service than that of veiling the facts. A theory disproved is a theory rejected, but unfortunately a theory which is merely redundant is often allowed to continue its existence. To this, from the point of view of the acquisition of facts, little objection might be taken. Redundancy of concepts is unscientific, yet it does not seem to offend the scientific mind as often and as definitely as it ought, but it is believed that the conception of the magnetic field can, and does, lead occasionally to erroneous results.

The facts of both permanent magnetism and electromagnetism present little difficulty in terms of the electron theory of matter. In the case of a conductor conveying a current, the "magnetic energy" may be considered as the kinetic energy of the moving electric field; it is not necessarily to be expected that the moving electric field should be evident from its electrical effects. In the steady flow of a current along a conductor the loss of free electrons from any element of volume is accompanied by a statistically equal accession, and the electric force experienced at any point due to the element is unchanged, except in so far as the motion of the electrons modifies their fields of force. In fact, the force due to any particular element may be zero, and there still be considerable kinetic energy.

But it is when we come to consider the relativity of energy that the conception of the magnetic field as a separate entity fails to satisfy. The kinetic energy of a moving mass with respect to an observer is measured by the product of one-half its mass and the square of the relative velocity of the body and observer. Without an observer, kinetic energy is meaningless.

The same body may possess different amounts of kinetic energy for different observers; to an observer moving with the same velocity as a bullet the latter possesses no kinetic energy, and is harmless. These features of moving material bodies are also characteristic of moving electric fields. Let us consider the radiation of an electromagnetic wave. This does not consist of the radiation of electric *and* magnetic energy; it consists of the radiation of an electric field. To an observer this field possesses energy of two kinds, one potential and the other kinetic, the magnitude of the latter being conditioned by the relative velocity of the field and observer.

If the direction of motion of the wave be from left to right in the plane of the paper, a stationary observer with the proper instruments will experience an inwardly directed magnetic force when the electric force is downwards, and an outwardly directed magnetic force when the electric force is upwards. As far as all stationary observers are concerned, the actual conditions could be exactly imitated by the fictitious radiation simultaneously of electric and magnetic fields suitably disposed. If such were actually the radiation, motion of the observer towards, or away from, the source of radiation would result only in a change of frequency of the observed effects. But this is surely not the case. The magnetic effect of a moving electric field is proportional to its velocity; to an observer travelling opposite to the direction of the wave the magnetic force is enhanced; in other words, the kinetic energy of the moving field is increased to such an observer. To one travelling in the same direction as the wave the magnetic force is diminished with the decreased kinetic energy, and to an observer travelling at the same velocity as the wave there is no magnetic force; for him the wave possesses no kinetic energy.

The magnetic field is not radiated with the electric field; it is not a self-existing entity. It only exists for observers over whom the electric field passes. The "magnetic field" is a function of two entities, viz., the electric field and the observer or detector; if either be absent, the phrase is meaningless.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS FOR JANUARY, 1921.

A slight improvement occurred in the position during January; exports rose by £71,048, or just over 4 per cent., while imports fell £75,454—17 per cent. Re-exports also showed a decline of 35 per cent. The principal increase in the export figures was represented by "other motors and generators," which rose 27 per cent.; appreciable increases also occurred in the export of insulated wire, glow lamps, meters, and telegraph and telephone wire and cable. The lower import figure was occasioned by declines in telegraph and telephone instruments and apparatus (44 per cent.), glow lamps, unenumerated electrical machinery, &c.

Values of Electrical Exports and Imports for January, 1921.

	Exports.	Imports.	Re-exports.
Electrical goods and apparatus (unenumerated)	£248,659	£109,941	£14,682
Insulated wire	392,250	11,838	—
Glow lamps	42,865	19,719	4,212
Arc lamps and parts	1,959	4,060	—
Batteries	86,008	17,764	—
Meters	49,141	16,329	4,750
Carbons	18,775	18,107	204
Electrical machinery:—			
Railway and tramway motors ...	33,287	—	—
Other motors and generators ...	243,397	—	—
Electrical machinery (unenumerated)	168,448	111,001	8,600
Switchboards (not telegraph or telephone)	22,408	218	60
Telegraph and telephone cable and material:—			
Telegraph and telephone wire and cable (not submarine)	197,482	15,851	—
Submarine telegraph and telephone cable	93,498	—	—
Telegraph and telephone instruments and apparatus	141,853	28,816	6,590
Totals... ...	£1,740,030	£353,644	£39,098

The total number of electric glow lamps exported during last month was 598,077, as against 134,968 in January, 1920, and 286,496 in January, 1913. The electrical glow lamps imports for the same periods were 226,591, 382,919, and 309,825 lamps respectively.

The weight of electrical machinery exports for January, 1921, reached 1,846 tons, as compared with 942 tons and 2,528 tons for January, 1920 and 1913.

LEGAL.

Failing to Fence Machinery.

David Muir, colliery manager, Auchterderran, and James Macfarlane, colliery manager, Bowhill Fife, at Dunfermline Sheriff Court, on Monday, were charged with failing to have properly fenced an electrically-driven shaft at a sawmill at the pithead of Bowhill Colliery, as a result of which a girl was caught and received injuries, from which she died. Both pleaded guilty. Agent stated a *bona fide* attempt had been made to fence the place, and for five years work had gone on without accident. The pit was the largest in Fife, there being a large number of officials upon whom duties devolved, and it was difficult for the two managers to see that everything was done. About five-sixths of the machinery was fenced, and in the opinion of the workers the place was perfectly safe. The Sheriff fined each £5 with the option of 30 days' imprisonment.

Quitman v. Amalgamated Electric Works.

In the Lord Mayor's Court, before the Common Serjeant (Mr. H. F. Dickens, K.C.), a claim was made by Messrs. Carl Quitman, glass merchants, 3, Cloth Street, Long Lane, E.C., against the Amalgamated Electric Works, Ltd., St. Mary Axe, E.C., for £35 2s. for white opal globes sold and delivered, or in the alternative, for goods bargained and sold.

Judgment was entered for the plaintiffs for the amount claimed, £35 2s., with costs.

Hartley v. Lancaster Corporation.

An action was brought against the Lancaster Corporation Electricity Committee at Lancaster County Court by Mr. W. Hartley, electric boot repairer, to recover £17 3s. 4d., alleged to have been overcharged in his electricity accounts during the past nine years. It was pointed out that under the Statute of Limitations only six years were recoverable, if anything. Plaintiff, who conducted his case in person, said he had recently discovered that he was charged for his motor as if it was 2½ h.p., when it was only 2 h.p. The difference in the rate was £1 against 16s. 9d. After a lot of argument, the chairman of the Electricity Committee offered him £4 to square the account, but he told him he would have half or nothing of the £17. For 40 bills he had been charged at the 2½-h.p. rate.

Major Milnes, electrical engineer, said the motor was in when he came to Lancaster, and plaintiff had made no complaint till now when he tested the motor and found its capacity was 2 h.p., but he had been charged at a comparatively easy rate. A motor could intermittently increase in load about 25 per cent.

His Honour sympathised with the plaintiff, and recognised he had been overcharged, but pointed out the accounts were settled and could not be reopened, though the Corporation had made a mistake.

Mr. Oglethorpe, for the Corporation, agreed to repay £4, and the case was withdrawn.

"Hotpoint" Electrical Household Appliances: Application for Trade Mark.

Mr. Justice P. O. Lawrence, in the Chancery Division, on Thursday, February 10th, gave judgment in an application by the Hotpoint Electric Heating Co., of Ontario, California, for the registration of a trade mark under paragraph 5, section 9, of the Trade Marks Act, 1905.

Mr. Kerly, K.C., who appeared for the applicants, said the opposition came principally from the Dowsing Radiant Heat Co., Ltd., who said that they had succeeded to the business interest of Messrs. Eastman & Sons (dyers and cleaners), Ltd., and Warne in the sale of "Hotpoint" flat irons.

Mr. Arthur Colefax, K.C., for the respondents, said the Dowsing Co. took over that business as from 1914.

Mr. Kerly, continuing, said that on January 23rd, 1917, the applicants applied to register as a trade mark the word "Hotpoint" for a considerable range of electrical appliances for cooking, washing, heating, and cleaning purposes, but the application was referred to the Court, and they were directed to serve notice upon the present respondents. He did not think there would be any question as regarded all kinds of electrical apparatus except flat irons. "Hotpoint" had for many years been distinctive of the applicants' goods, but he claimed that for flat irons as well. He could not dispute, however, that to his knowledge since 1910 the respondents had used "Hotpoint" for certain flat irons which were not the applicants', but he would ask his Lordship to say that the latter began business before the respondents. There was a good deal of confusion in the minds of the public with regard to the word "Hotpoint," and the respondents' irons had been mistaken for those of his clients. He was not suggesting that there had been any fraud, but it might be that there ought to have been concurrent registration. Confusion, he said, had been constant with regard to the applicants' irons, which had frequently been sent to the respondents for repairs.

Mr. P. H. Booth, vice-president of the applicant company, said there was substantial use of their flat irons in this country before 1911 under the name "Hotpoint." He knew that from 1909 onwards the respondents had been advertising "Hotpoint" irons here. He was unable to say whether the first newspaper advertisement of the applicants here was on May 13th, 1915.

Mr. Danckwerts, who represented the Board of Trade, contended that the word "Hotpoint" being descriptive, the evidence as to user, in order to make it distinctive, must be clear and satisfactory, which was not so in this case. User, in fact, was comparatively short, and there was every possibility of confusion in the case of the flat irons, as "Hotpoint" irons were made by other people.

His Lordship held that apart from flat irons, the word "Hotpoint" had become distinctive of the applicants' goods; and he saw no ground for saying that, because there might be some confusion in the minds of persons buying flat irons, this was a good reason for refusing the mark in respect of the other appliances. He directed the Registrar to proceed with the application.

Craig-McKerrow v. Matthews & Yates, Ltd.

Mr. Pollock, High Courts Official Referee, on February 14th, concluded an action in which Mr. Robert Craig-McKerrow, trading as the Rowley Mills, Avington, Gloucester, claimed from Messrs. Matthews & Yates, Ltd., electrical, ventilating and heating engineers, of the Cyclone Works, Swinton, Manchester, £5,309 for breach of contract in the erection of a drying plant and loss of profit from the failure of the plant to perform the duties required of it.

It was alleged that the defendants failed to complete the installation within the specified time, and that when erected it was found to be inefficient and incapable of doing the amount of work required of it.

The Official Referee decided that it was a condition precedent with regard to the delay that a class A certificate should be procured, and as to the damages claim on the ground that the machinery did not do the work required of it, he found that the defendants had done all the work they contracted to do. He therefore gave judgment for the defendants on the claim, and on the counterclaim for the price of the machinery. The judgment would be for the defendants for £1,055 10s., with costs of both claim and counterclaim.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Charging Batteries for Motor Cars.

The letter from Messrs. Rootes, Ltd., in your issue of January 28th has made me wonder why the mercury vapour rectifier for converting a.c. to d.c. is not better known, as applied for charging purposes.

I, for one, until recently, imagined that the mercury vapour rectifier was only suitable for use in the laboratory, but have found, however, that the mercury vapour rectifier is a sound commercial proposition, especially for charging accumulators, as mercury vapour rectifiers lend themselves admirably for this purpose, being efficient and exceedingly flexible.

I would recommend Messrs. Rootes to get into touch with the Hewittic Electric Co., Ltd., of 80, York Road, King's Cross, the manufacturers of these outfits, who could no doubt give them any information regarding the question.

Watford. **D. V. Tustain.**
February 10th, 1921.

The Reduction in Price of Lamps.

I am pleased to see the letter of Mr. Scarborough in your issue of February 11th, as I think this business has been mismanaged.

I proposed to the E.L.M.A. that as so many dealers had large stocks of lamps on hand a clearing house should be established to which any dealer who chose to do so could send up a list of his stock. When any order was received at any lamp factory, the clearing-house list would first be consulted. If the lamps required could be supplied from any stock they would be, instead of manufacturing a further lot and adding to the congestion. In this way a glutted market would be cleared, and the makers would then have been free to reduce prices without hardship, or increase them without fear of an overstocked market. In other words, a more healthy condition would have been created.

Any dealer availing himself of the clearing house would pay a percentage fee to cover costs. I am sure most dealers would have borne the slight loss this might have entailed.

In other trades a dealer is free to have a clearance sale if he finds himself overstocked or stocks moving too slowly. In the lamp trade we are tied hand and foot, and may not even deal fairly with our customers, as, if a lamp is broken in transit in January and the maker delays to credit it till February, he does so at a lower price. The breakage or fault may have occurred on January 31st, and the credit be granted on February 1st, nevertheless the purchaser will lose by the amount of the price reduction.

I trust the matter will be pursued further or that the E.L.M.A. will see how much they are in danger of injuring their own cause unless they reconsider their scheme.

Glasgow, *February 14th*, 1921. **J. A. Rudd.**

I have read Mr. Scarborough's letter in your last issue with some amusement. My sympathy will be with him in his complaint if he will convince me that he sent a cheque to the "wicked" members of the Electric Lamp Manufacturers' Association for the increased value created in his stock when the price of lamps was put up some time ago.

Some people want it all ways.

The fact is, the credit he is to receive on his January stock is a generous gift.

Lamp Salesman.

February 12th, 1921.

The Electrical Wholesalers' Federation, Ltd.: A Correction.

With reference to the report in your paper of the annual meeting of the Electrical Wholesalers' Federation, Ltd., permit me to correct an error in the last paragraph, as I am sure you like your reports to be accurate. I am as proud of my name as I am of being a member of the E.W.F. and of its chairman; perhaps you will be good enough, therefore, to correct it.

H. Boden How.

Sheffield, *February 14th*, 1921.

[We tender our sincere apologies to Mr. Boden How for the unfortunate mistake in our report.—Eds. Elec. Rev.]

A Flashing Problem.

Referring to the above problem by "Dense," dated February 5th, I would have suggested, had he not stated that his connections were correct, that in changing the direction of rotation, he was doing this by reversing the current through the armature only and not, as of course, should be done, by reversing the current through the armature and interpole windings together.

F. W. B.

Birkenhead.
February 12th, 1921.

In reply to "Dense's" question in your issue of February 11th, I would suggest the following:—

1. Test the current taken by the motor when running in each direction with full load, to prove that the motor is not overloaded.

2. Test the polarity of the main and interpole coils; it is probable that the polarity of the interpole may be reversed.

(For a motor the polarity of the interpole is the same as that of the main pole behind it following the rotation, and a small compass needle will indicate the polarity.)

For a reversing motor the brushes should remain in the neutral position immediately under the centre of the interpole coil, as it is certain a movement in one direction must react when reversing if the motor is giving full-load output in each direction.

If the motor is fitted on a crane or charging machine, it is possible that the trouble may be due to the method of control or braking, and particulars should be given as to the motion, if arranged for creeping speeds by armature diverter or high speeds by series field diverter, if rheostatic braking is employed, if the shunt solenoid brake coil is wired across the motor terminals, or if it is coupled electrically or mechanically with another motor working on the same load.

From my experience, the mechanical brake fitted on a crane may give rise to trouble due to "locking," and to unlock may require excessive current. To test if the trouble is due to mechanical or electric braking it would be better to uncouple the motor and arrange a brake test or electric loading test, running the motor in each direction with half and full load, using a plain series reversing controller. (Care must be taken not to run the motor with no-load, as it may exceed its critical speed.)

It would be interesting to hear if the above suggestions have been tried.

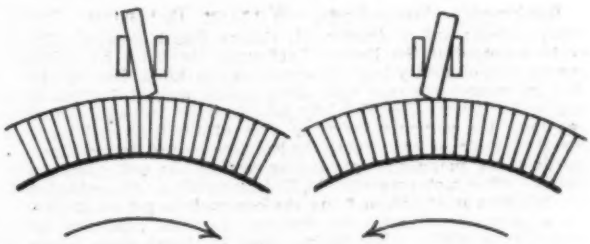
G. W. T.

Glasgow.
February 14th, 1921.

Perhaps my own experience of similar troubles may be of some assistance to "Dense" (February 11th).

It is evident that the sparkless brush position of the machine when running in one direction, which becomes a flashing position on reversal, is not the true reversing position, and I would suggest that possibly the solution to the problem is one of the following cases:—

Either the brushes may be a trifle loose in their holders which would cause uneven wear, as they would be dragged forward by their friction with the commutator in the direction of rotation, as per diagram.



It will be seen that this fault will automatically vary the real brush position slightly on reversing from either direction, as the brush only beds on one half at a time, and this is sometimes sufficient to cause the flashing noticed by "Dense."

Or the interpoles may be a little too strong or weak. To test for this:—

(1) Impose a small current on the interpole coils from a low-voltage generator, varying it while attempting to find a brush position which gives sparkless commutation and the correct load speed curve in either direction.

(2) Divert current from the coils with a variable resistance and test as above.

R. W. Kinch.

Woking.
February 14th, 1921.

Referring to a letter under the above heading in your issue of the 11th inst., the trouble here is caused by local currents in the short-circuited coils of the armature. These local currents may be of considerable magnitude owing to the low resistance of the armature coils, and can do much harm by overheating the armature, overloading the brushes, and more particularly by dissipating their energy in the form of a series of sparks, and in extreme cases flashes, at the brushes when the short-circuit is broken, thereby burning the brushes and damaging the commutator.

To get good commutation and to prevent the waste of energy, these local currents must be brought within reasonable limits, and the nearer they can be completely stopped the better.

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To try and stop these local currents it is essential that the short-circuited coils should be in the weakest part of the magnetic field. It is interesting to note that when the brush position was altered on this particular machine the flashing stopped, and the effect of altering the brushes was to bring the short-circuited coils into a weaker field. Then the commutating poles should be examined to find out if they are functioning correctly, for their object is to keep the weakest part of the magnetic field in as fixed a position as possible so that the brushes need not be shifted at any time. Then it is very important that the brushes should have sufficient resistance at their face to stop these local currents. There is a material, called the M.P. commutator compound, which considerably helps in this direction. It is put up in the form of a stick, and the end of the stick is gently rubbed on the surface of the commutator when running. Some of this material gets under the faces of the brushes, and, amalgamating with the carbon, forms very thin but high-resistance films, and these high-resistance films have been successful in stopping the local currents.

By making certain that the short-circuited coils are always in the weakest part of the magnetic field, and that the brushes have sufficient resistance at their faces, this machine can be cured, and I have no hesitation in saying so, for in some twenty years' experience in commutation I have yet to find a case that could not be cured when working on the above lines.

S. W. Martyn.

London, *February 15th*, 1921.

Electricity Supply from Surplus Sources.

I have read with very great interest the letters by Mr. Pain in your issue of January 14th and of the 4th inst., also Mr. Hugh Seabrook's addition to the subject.

This subject is of vital importance, not merely as concerning individual companies but as a national economy. I notice that blast-furnace and coke-oven gas has been mentioned, and although I have dealt with this subject previously, I would like to add to it now, as some advancement has been made during the past year.

Mr. Pain mentions "ghastly waste." Now, in the Middlesbrough district there are about 75 blast furnaces and a good number of coke ovens working, and a tremendous amount of this gas is discharged to the atmosphere, so much in fact that it has been reported by aviators that Middlesbrough is obscure on an ordinary day, and yet Middlesbrough is purchasing power supplied from coal-fired boilers at a very heavy cost, and consuming a commodity of vital importance for export to increase our overseas trading.

One large works in this country has set an example, and is still working hard for even better results, and so far as fuel economy and efficiency on waste products are concerned has excelled the Americans and our continental neighbours, its efficiency now being in the neighbourhood of 25 per cent. above any figure obtained abroad.

We have the spare gas in this country, and we have the gas engines, home-designed and built, and have performances second to none in the world.

I am not surprised to read that Mr. Seabrook was unable to work up any enthusiasm at 2¼ lb. of coal per kWh at, say, 31,500 therms., when this is being produced for 15,000 therms. per kWh on gas engines.

Regarding the exchange or sale of this surplus energy, it could be sold to the power companies or corporations at a figure much below their coal costs per unit generated; both parties would be in hand financially, and the nation would have reserved or available for export several million tons of coal per annum.

Fuel economy now is one of the many lines open to reinstate this country in a prosperous condition, and should be taken up seriously by the Government. We have stuck too long to our steam-electric plants, until most people are very loath to leave them even for greater efficiencies and lower working costs.

If we ever come to a time when we are restricted to therms expended per b.h.p.-hour, I hope it will not even be based on 2¼ lb. of coal per kWh, but something very much below that figure; then we may hope for cheaper production and greater outputs. The economy of fuel is just as important as the wages question.

I do not hope that our total power requirements can be supplied from waste heat, but a great portion can, and should be, in place of coal-fired boilers.

With the surplus supply stations linked up with the larger coal-fired stations we should have a very good combination, and would in many cases reduce the spare or stand-by plant at the larger stations.

S. H. Fowles, A.M.I.E.E., A.M.I.Mech.E.

Jarrow, *February 14th*, 1921.

BUSINESS NOTES.

Bankruptcy Proceedings.—William Drysdale, electrical engineer and contractor, 24, Paxton Street, Barrow.—The debtor appeared at the Barrow Bankruptcy Court for his public examination on Friday last. In answer to the Official Receiver, he said he started business with £200 capital, and £150 given to him by his father. He did chiefly jobbing work, but also carried out some big contracts, including that of the local workhouse. For the last six or nine months he had been pressed by creditors, and had five judgments outstanding against him, and when the Sheriff's officer took possession, he filed his petition. He estimated his liabilities at £2,025, and the stock-in-trade he put at £1,249. There were in addition the fixtures, &c. His deficiency he estimated at £661. After taking stock he found there was a tremendous loss on English manufactured goods. He had drawn £5 10s. per week out of the business for himself, and had also at one time spent money in travelling to Manchester and Liverpool once a week. He personally superintended the books, and had not spent an unusual amount in expenses. At one time he thought of taking a partner, and after an inspection of the books it was estimated that the income from the business for 1918 was about £800, without taking into account management charges. On the same basis, the estimate this year was £1,000. The business had fluctuated during the war and since, and he had been left with only one man. One of the causes of his failure was want of capital, and the stock was much heavier than he thought it was. In December, 1919, the cash sales were £264, but he did not think they would be £160 in December, 1920. He had had a nervous breakdown, and suffered from neuritis, and had attended his business when hardly able to walk. Answering the Registrar, the Official Receiver said the books had been fairly well kept until recently, and the trustee was of opinion that it was not necessary to ask for a further account. The examination was closed.

J. V. Bell, electrical engineer, 21, North Bar Within, Beverley, York.—Receiving order February 7th on debtor's own petition.

A. E. Channon, H. S. Naden, and C. G. Channon (A. E. Channon & Co.), electrical engineers, Cheltenham.—First and final dividend of 4s. 8¾d. in the £, payable February 18th, at the Official Receiver's Office, 26, Baldwin Street, Bristol.

J. Jones and J. R. Jones (J. Jones & Son), electrical engineers, 7, Chapel Street, Penzance.—Receiving order made February 9th on debtor's own petition.

J. C. Thomson, electrician, lately electrical engineer and contractor, late of Station Street, Mansfield, Notts.—Last day for proofs for dividend, February 25th. Trustee, Mr. E. W. Humphreys, Official Receiver, 4, Castleplace, Nottingham.

A. Lord, electrical contractor, 33, Westgate, Burnley.—First meeting February 25th, at the Official Receiver's Offices, 13 Winckley Street, Preston; public examination, March 10th at the County Court House, Burnley.

A. Dickinson (Crown Electrical Co.), electrical engineer and contractor, 157, Hunslet Road, Leeds.—Receiving order made February 5th on debtor's own petition. First meeting February 23rd, at Official Receiver's Offices, Leeds; public examination, March 8th, at the County Court House, Leeds.

B. E. Thomas, electrical engineer, 12, Castlemeadow, Norwich.—Last day for proofs for dividend, March 2nd; trustee, Mr. H. P. Gould, Official Receiver, 8, Upper King Street, Norwich.

Copper and Lead Prices.—Messrs. F. Smith & Co. report February 15th:—Copper (electrolytic) bars, £79, £2 inc.; ditto sheets, no change; ditto wire rods, £95, £2 inc.; ditto h.c. wire, 1/0 ⅛, ¼d. inc.; silicium bronze wire, no change.

Messrs. James & Shakespeare report February 15th:—Copper bars (best selected), sheets and rods; no change. English pig lead, £23; £1 dec.

Dissolutions of Partnership.—Blower & Cooper, electrical and engineering suppliers, 3, Paul's Bakehouse Court, E.C.—Messrs. A. E. Blower and A. Cooper have dissolved partnership so far as concerns Mr. A. Cooper, who retires from the firm.

Andrews & Morland, electrical engineers, 21, Westbourne Street, Kingston-upon-Hull.—Mr. J. Andrews and Mr. F. H. Morland have dissolved partnership. Mr. Morland will attend to debts and continue the business in his own name and at the same address.

Smith & Scragg, motor and electrical engineers, Nantwich Road, Crewe.—Mr. W. Smith and Mr. G. J. Scragg have dissolved partnership. Mr. Smith will attend to debts.

A. H. Foster & Co., motor and electrical engineers, &c., 679A, Romford Road, E.—Mr. A. H. Foster and Mr. J. Froelicher have dissolved partnership. Mr. J. Froelicher will attend to debts and continue the business.

Company Liquidations.—Leeds Alliance Electrical Manufacturing Co., Ltd.—Winding-up voluntarily. Meeting of creditors was called for February 17th, at 62, Albion Street, Leeds. Liquidator, Mr. S. S. Tadman, 1, Albion Street, Leeds. Particulars of claims to be sent to the liquidator by March 16th.

Britannia Lamp and Accessories Co., Ltd.—A meeting of members is called for March 15th, at 24, Coleman Street, E.C., to hear an account of the winding-up from the liquidator, Mr. R. E. Tayler.

Rotax Motor Accessories Co., Ltd.—Winding up voluntarily for reconstruction purposes. Liquidators, Mr. W. Morris, 6, Caven-

dish Square, W., and Mr. A. Bell, Rotax Works, Willesden Junction, N.W.

Argentine Electricity Co., Ltd.—Winding up voluntarily. Liquidator, Mr. T. S. Hamilton, 62, New Broad Street, E.C. Meeting of creditors, February 23rd, at New Broad Street.

Trade Announcements.—Messrs. Albert Lee & Co., Ltd., of 8 and 9, New Zealand Avenue, London, E.C. 1, have opened an illuminating engineering department, under the management of Mr. Sydney Smith, who was for some time demonstrator for the Metropolitan-Vickers Electrical Co., Ltd., and previously to that was with the Holophane Co. Mr. Smith will take charge of the sales of the helium fittings and other scientific types of glassware for use in special forms of lighting, and will give expert advice regarding lighting methods for shops, factories, offices, &c. He will lecture in various parts of the country.

Messrs. Southgate (Birmingham), Ltd., of Birmingham, manufacturers of electric, gas, and oil fittings, have appointed Mr. Wm. Broadbent, 11, Wellington Street Moss Side, Manchester, as their representative in Lancashire and the North-Western Counties.

Messrs. H. W. Smith & Co. (1920), Ltd., have appointed Mr. W. T. Rushton, late of the Fuller Electrical and Manufacturing Co., as one of their representatives for the sale of cables and wires in London.

The business of Messrs. Macdonald & Co., electrical engineers, of 15, Bridge Street, Rotherham, has been amalgamated with that of Messrs. Slack & Co., of 98, Main Street, Rotherham.

Mr. J. T. Baring has entered into partnership with Messrs. Williams & Pell, of 5, Chancery Lane, London, W.C. 2, agents for the Electrical Alloy Co., the Industrial Filtration Corporation, La Métallurgique Electrique, and the British Electric Plant Co, Ltd. The business will be carried on under the style of Williams, Pell and Baring, at the same address.

Mr. C. B. Maurice, who has been appointed sole selling agent in London for Messrs. Cranmore & Co., Ltd. (conduits and fittings), Birmingham; J. Hall & Co. (switches, fittings, &c.), Birmingham; W. H. Cheadle & Waltho, Ltd. (lampholders), Wolverhampton; Electric Heating and Hardware, Ltd. (electric irons, kettles, and heaters), Birmingham; Seneffe Cable Works, Belgium; and "Regina" and "Bissell" electric suction cleaners, has opened offices and showrooms at Berwick House, 139, Oxford Street, W.1, and a warehouse at 3, Manette Street, W.1. Telephone: Museum 3627.

Messrs. Scholey & Co., Ltd., 56, Victoria Street, Westminster, announce that from February 21st their head office will be transferred to their works. After that date their address will be:—Scholey & Co., Ltd, Victory Works, Gloucester Road, Croydon. Telephone: Croydon 2164.

Catalogues and Lists.—The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4. Folder L,2449. Illustrating and describing "Sonorus" high-voltage electric trembling bells and "Link" and "All-china" bell-pushes; all items fully priced. Folder No. H,2446, giving details and prices of "Magnet" electric irons. Installation Leaflet P. 2,452.—An illustrated description of the electrical equipment of the Brighton diamond-cutting factory.

English Electric and Siemens Supplies, Ltd., Foster's Buildings, 22, High Street, Sheffield.—Leaflet B1, a priced, illustrated and dimensioned description of "Britannia" "half-watt" lanterns for lamps up to 1,000 watts. Leaflet 54, an illustrated folder giving prices of "Britannia" vacuum and gasfilled lamps.

The Edison Swan Electric Co., Ltd, Ponders End, Middlesex.—List No. A.A.178, dealing with "Ediswan" enclosed oil switches with full specifications and illustrations. Progress Sheet No. 48, illustrating and describing "Revo" house service switches and fuse-boxes. Priced.

Messrs. Phillips & Turner, 115, Edmund Street, Birmingham.—A leaflet illustrating ceiling fittings—galleries and ceiling plates.

Messrs. E. Shipton & Co., 52, Floral Street, Covent Garden, W.C. 2.—A leaflet illustrating and setting forth the advantages of an "interphone" system; it also deals with "Westophones" for short-distance telephony.

Messrs. Hollings & Guest, Ltd., Thimble Mill Lane, Birmingham.—List No. 109A, an illustrated and priced list of hydraulic presses with hot plates for various purposes; List No. A110, a priced catalogue illustrating hydraulic forcing presses for fixing or removing wheels, armatures, commutators, &c.

Mr. L. Rosenkart, 4, Oxford Street, W. 1.—Folder, dealing with "Alterna" cycle-lighting outfits.

Southern Electric Co., Ltd., 138, Southwark Street, S.E. 1.—Net trade price-lists of electrical accessories and appliances, including cut-outs, switchgear, adapters, bells, irons, flexibles, &c.

Messrs. Henry G. Richardson & Sons, Wordsley Flint Glass Works, Stourbridge.—A leaflet showing applications of "Levahook" fittings to lighting bowls.

Messrs. Crow, Toogood & Co., 15, Wardour Mews, D'Arblay Street, Wardour Street, W. 1.—An illustrated catalogue of electrical fittings and accessories, including bowl fittings, cast-iron watertight fittings, brackets and pendants. Also a net trade price list of electrical fittings of a large variety.

Messrs. E. P. Allam & Co., 107-109, Gray's Inn Road, W.C. 1.—Monthly Stock List (No. 6) of d.c. motors, for sale or hire.

Messrs. Harry H. Gardan, Ltd., Staines.—Stock list of dynamos and motors.

Calendar.—Messrs. Moir & Watts, of Weardale Road, Lee, S.E. 13, have issued a pictorial calendar with monthly tear-off sheets.

For Sale.—The Z Electric Lamp and Supplies Co., Ltd., of 73, Newman Street, W. 1, has issued a schedule of stocks of electrical accessories, electrical heating apparatus, &c., of which it is disposing on behalf of the liquidator of the Z Electric Lamp Manufacturing Co., Ltd.

Stoke Newington Borough Council Electricity Department invites offers for a battery and charging plant.

By direction of the Disposal Board, Mr. C. D. Phillips will sell by auction, on March 10th, at No. 18, C. S. Depôt, Swindon, machine tools, and electrical and general plant, &c.

By direction of the Disposal Board, Mr. C. D. Phillips will sell by auction on March 15th and following days, at the National Cartridge and Box-Repair Factory, Newport, plant, machinery, &c.

By order of the High Court, Chancery Division, Messrs. Davis and Moon will sell by auction on March 1st, at Clapton, and March 3rd, at Battersea, the stock, plant, fittings, &c., of Messrs. Foot and Milne, electrical contractors.

By direction of the Disposal Board, Messrs. Harris & Gillow will sell by auction, on February 23rd and following days, at Shoreham Camp, Shoreham-by-Sea, camp equipment, saddlery, and tools, telephones, Fullerphones, &c.—For particulars see our advertisement pages to-day.

Electrical Wages in Scotland.—The Scottish Contractors' Association has suggested to the Scottish District Committee of the Electrical Trades Union that a conference should be held to consider the wages question. The operatives have put in a claim for an increase of 6d. per hour on present rates, while the employers, on the other hand, desire a reduction of 3d. as from February 28th.

Socials.—A number of well-known artistes appeared at a concert in the Cambridge Hall, Southport, on February 9th, in connection with the Southport Corporation Tramway Employés' Social and Athletic Society. There was a large audience, and the proceeds were divided between the Society's funds and the Infirmary.

A social in connection with the Assembly Department (Lamp Works) of the English Electric Co., Preston, took place at the Canteen Theatre, on February 11th. The M.C.'s were Messrs. A. De Boeck and A. Handley.

On Thursday, February 10th, a fancy dress carnival was held by members of the Igranic Electric Co. with their friends, at the Café Dansant, Bedford, when a most enjoyable evening was spent by about 350, fully two-thirds of whom were in fancy costumes. During the interval, supper was served, after which there was a grand spectacular parade. The judges experienced great difficulty in making their choice for the six prizes. Dancing continued into the small hours.

The staff of the General Electric Co., Ltd., Newcastle Branch, held their second dance of the season, on Friday last, at Heaton Assembly Rooms. The company numbered 200, and the Committee also arranged a whist drive, for which handsome prizes were given. Music was rendered by Mr. R. Jackson's orchestra, augmented by two members of the staff—Mr. F. E. Winnard and Mr. C. N. Baston. Prizes were presented to the successful whist players by Mrs. J. Spence.

Applications for British Trade-Marks.—Appended is a summary of the recent applications for British trade-marks in respect of articles and goods associated with the electrical trades and industries:—

Apex. No. 401,508, Class 6.—Dynamos, dynamo brushes, electric motors, &c., Wm. J. Goodebridge, Colmore House, 21, Waterloo Street, Birmingham, March 5th, 1920.

SB. (letters and design), No. 409,357, Class 13.—Incandescent lamps (ordinary) and other electric fittings, John Agerup, Vulcan House, 56, Ludgate Hill, London, E.C. 4, November 2nd, 1920.

Graham (lettering and design). No. 407,386, Class 8.—Permanent magnets sold separately, E. G. Graham, trading as Alfred Graham and Co., St. Andrew's Works, Crofton Park, London, S.E., August 30th, 1920.

Amplion, No. 408,176, Class 8.—Telephonic Apparatus, E. G. Graham, trading as Alfred Graham & Co., St. Andrew's Works, Crofton Park, London, S.E., September 25th, 1920.

Benjamin, No. 404,928, Class 13.—Electric fittings and motor accessories, Benjamin Electric, Ltd., Brantwood Works, Tariff Road, Tottenham, N., June 2nd, 1920.

Rotomotor, No. 406,900, Class 6.—Dynamo-electric machinery, Leonard Barlow, trading as Barlow & Young, Buckingham House, Palace Street, Westminster, S.W., August 13th, 1920.

Geeko, No. 406,388, Class 6.—Telephones and parts of telephones, General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C., July 23rd, 1920.

Lyken, No. 409,572, Class 8.—Apparatus for electro-deposition, Hockley Chemical Co., Ltd., 1, Hockley Hill, Birmingham, November 10th, 1920.

The Bergmann Electricity Works.—It is reported that negotiations are proceeding in Germany with a view to the establishment of a close connection between the Klockner group (Haspe Steel Co., Lorraine Hutten Verein, &c.), and the Bergmann Electricity Works, Co.

Wolfram Lamps.—The share capital of the Wolfram Lamp Co., of Augsburg, is being increased to 5,000,000 marks to defray the cost of extending the filament factory.

Burglary.—The premises of the "Xtra" Lighting Co., Sunderland, were recently broken into, and a number of electric torches, &c., were stolen. By good fortune the managing director, Mr. A. J. Harrison, had occasion to return to the shop after the closing hour, and disturbed the thieves.

Jugoslavia Electrification Development.—The following translation of an article from the *Agramer Tageblatt* of Jan. 20th, 1921, has been received in the Department of Overseas Trade from the Commercial Secretary to His Majesty's Legation at Belgrade (Captain E. Murray Harvey):—

"For some time past the Ministries of Communications and Public Works have been in consultation regarding the formation of a technical commission for the purpose of drawing up a plan for the electrification of Jugoslavia. This plan is now adopted, and all the general lines of the work have been laid down. Henceforth the State will have the first right to create any electrical undertaking, but private individuals may carry out electrical undertakings where the State has not constructed such; the special permission of the Ministry of Public Works is necessary in such cases. The State is enabled, if necessary, to expropriate such individuals on condition of indemnification. The State may also nationalise existing undertakings so far as is conducive to the above end. The upkeep of the transmission and cables devolves on the electrical administration of each Commune. The highest advisory body on electrical questions is the Electro-technical State Council, which is composed of 15 members and 16 deputisers (substitutes). The Council will include representatives from the Ministries of Commerce and Industry, Public Works, Agriculture, Forestry, and Health, the Electro-technical Engineering Faculty, and the Law Society. As a means for controlling the revenue from electric power, an electro-technical finance committee will be set up at the Ministry of Trade. The manner in which the Ministry of Works will carry out the scheme will be promulgated in a special order. As present conditions render this project very urgent, the preamble will be laid before the Constituent Assembly as soon as drawn up."

The Dalmatian Bauxite Deposits.—The deposits of bauxite in Dalmatia and Istria first attracted special attention during the war, when it was found necessary by Germany to replace the French product. Exports of small quantities were first sent to Germany in 1916, the tonnage being considerably increased in the following two years. Italian newspapers state that only the deposits in the vicinity of the sea, both in Dalmatia and Istria, have yet been worked, and the production only extends to a depth of a few metres. Nevertheless, the deposits are said to be very productive, and the question of establishing an aluminium industry in Dalmatia has been brought forward, as the deposits in this region alone are sufficient to justify the erection of a works, while the existing waterfalls would supply the necessary power.

E.D.A. Activities.—Another bunch of pamphlets has reached us from the director and secretary of the E.D.A. "The World's Right Hand" is a little review of man's deliverance from slavery; the slavery of other men and that of circumstances which from the earliest times have forced him to employ laborious methods to accomplish his necessary tasks. It leads up to the electrical era, and forecasts a bright future to be brought about by electricity. Another leaflet illustrates a number of electrical appliances, and says: "There is an electrical appliance described here that will interest you." "E.D.A. 72" shows how the fuss and trouble attendant upon that hardy perennial "spring cleaning" may be disposed of by electrical means. Two book markers deal with electric irons and lighting, and cooking is treated of in "A Message to the Housewife Who Knows." A pamphlet illustrated in colour exhorts the reader to "Use Electricity—The Silent Servant," and emphasises the ease of control of electrical cooking operations, as well as the many other inherent advantages of this means of preparing food. These items can be obtained from the Director at 84, Kingsway, W.C. 2.

Proposed Increases in Spanish Tariffs.—The *Bulletin* of the F.B.I. states that the reduction in freight rates to Spain, announced in January, should do much towards the development of Anglo-Spanish trade. It is feared, however, that a serious check to such development may be presented by the duties imposed under the Revised Spanish Customs Tariff, to be issued shortly. It is understood that a provisional tariff, embodying the suggestions of the Tariff Advisory Committee, will be substituted for the present tariff in March next. This will, in its turn, be succeeded by a permanent new tariff, which should have replaced the 1912 tariff in 1917, but whose introduction has been delayed from year to year. Further information—not yet confirmed—announces the introduction of a permanent tariff in March, without the provisional stage. Opinion among Spanish consumers, who are anxious to reap the benefit of the present tendency for prices to fall, is strongly opposed to tariff increases. The iron and steel interests of the north and the textile manufacturers of Catalonia, on the other hand, are pressing vigorously for a drastic heightening of the Spanish tariff wall, in order to ensure their war-time level of profits. The F.B.I. is keenly alive to the urgency of the situation from the point of view of the British manufacturer. Firms interested in the Spanish trade are invited to communicate with the South European Section, at head office, as early as possible.

New Indian Companies.—Among the new companies recently formed in India are the following:—The Kadi New Industrial and Electric Co., Kadi, Baroda, capital 250,000 rupees, to carry on business as engineers and pressers of jute, and to supply electricity, &c.; the Sidhapur Electric Industrial Co., Sidhapur (Kadi), capital, 700,000 rupees, to manufacture cloth by electric power; the Electric and Automobile Engineering Co., Delhi, capital 2,000,000 rupees, and the East India Electric Supply and Traction Co., 11, Portuguese Church Street, Calcutta, capital 2,500,000 rupees.

Electrical Manufacture in Belgium: British and American Interest.—An account of the steps taken by British and United States electrical manufacturing interests to participate in Belgian developments is given in a recently issued report by the American Consul-General at Brussels. The movement has, of course, for its principal object the capture of a share in the contracts for the electrification of the Belgian State Railways. The centre of this electrical manufacturing industry is Ghent, where great activity has prevailed since the Armistice, largely through the influence of British and American engineers and financiers. During the year 1919 the two concerns most occupied before the war were entirely reorganised and merged into large international companies with greatly increased capital.

Three concerns are now engaged in the business:—"The Société d'électricité et de Mécanique" (international), the "Constructions Electriques de Belgique" (international), and the "Ateliers de Constructions Electriques des Flandres." The first-named is the result of a merger which absorbed the "Usines Carels Frères" (a pre-war Belgian company making Diesel engines), and its capital stook of 10,000,000 fr. The new company increased its capital to 36,500,000 fr., an American, a British, and a French electrical manufacturing company each having a quarter interest in the new concern. Belgian banks and a large Belgian financial and industrial company are also interested. Its plans include the production on an increased scale of steam engines and Diesel engines, with the addition of electrical material, the latter being undertaken with the assistance of American experience and designs.

In November, 1918, there was formed at Paris a company called the "Constructions Electriques du Rhone," for the purpose of constructing electrical material. This concern secured a contract for using the patents and processes of the English Electric Co. The "Constructions Electriques du Rhone" then increased its capital to 40,000,000 fr., and changed its name to "Constructions Electriques de France." Before this, with a view to further extension, it had created in Belgium a subsidiary company called the "Société Auxiliaire de Constructions Electriques de Belgique." Later, this company secured the help of the "Compagnie Internationale d'Electricité de Liége," and bought up the "Société Anonyme des Anciens Ateliers van den Kerchove," of Ghent. In April, 1920, the "Compagnie Internationale d'Electricité," of Liége, and the "Etablissements van den Kerchove," of Ghent, were merged under the name "Constructions Electriques de Belgique," with a capital stook of 40,000,000 fr. and administrative offices at Brussels. Before the war the "Etablissements van den Kerchove" constructed engines and steam turbines. Since fusion the plant is being greatly enlarged, and has included the construction of electrical material of all kinds. The English Electric Co. is helping both the French and the Belgian companies in every way possible, and is perfecting the plant at Ghent. A third company, the "Ateliers de Constructions Electriques des Flandres," has been formed at Ghent lately with a capital stock of 2,000,000 fr., made up of 2,000 shares of 1,000 fr. each. Its purpose is the manufacture and repair of electrical material, as well as the installation and production of electromotive power in all forms.

Research Association for Cast Iron.—The Secretary of the Department of Scientific and Industrial Research announces that the Research Association for the Cast Iron and Allied Industries has been approved by the Department as complying with the conditions laid down in the Government scheme for the encouragement of industrial research. As the Association is to be registered as a non-profit-sharing company, the promoters have applied to the Board of Trade for the issue of a licence under Sec. 20 of the Companies' (Consolidation) Act of 1908. The secretary of the committee engaged in the establishment of this Association is Mr. Thomas Vickers, 174, Corporation Street, Birmingham.

A Canadian Copper Works.—The Eugene F. Phillips Electrical Works, Ltd., of Montreal, is proceeding immediately with the construction of a copper rod rolling mill having a daily capacity of 100 tons. In designing the mill, provision has been made to allow for an extension for the rolling of copper sheets and the drawing of copper tubes, as well as for the erection of a small refinery to take care of the copper scrap from the mill, and also from the company's large wire and cable factory. For the immediate future the company will import electrolytic copper wire bars, but it is hoped that within the course of a few years these bars will be produced in Canada in sufficient quantities to make the electrical industry in the Dominion self-supporting so far as copper is concerned. The managing director of the firm is Mr. Lawford Grant, formerly with the British Insulated and Helsby Cables, Ltd.

British Industrial Films, &c., Wanted for University of Hong-Kong.—The Acting British Commercial Secretary at Hong-Kong has been approached by the University of Hong-Kong for assistance in a new scheme for commercial training, which has recently been started there. The course of study for the Degree of Bachelor of Commerce includes lectures on Industry, Trade and Transport. In connection with these, the University has expressed the desire to receive from United Kingdom manufacturers for exhibition purposes lantern slides and, if possible, kinematograph films illustrative of the processes used in a number of industries, including textiles, tools and machines. Illustrated catalogues and large-sized photographs of works, &c., would also be welcomed. It will probably be of interest to United Kingdom manufacturers to supply the University with material of the nature indicated, and communications should be sent direct to Prof. W. J. Hinton, University of Hong-Kong.

Flexible.—In their advertisement appearing in this issue, the Edison-Swan Electric Co., Ltd., give certain particulars for specifying size of conductors, quality of insulation, and finish, which are intended to form a useful guide to buyers.

Australian War Precautions Act Repealed.—An Act to repeal the War Precautions Act, 1914-18, was passed by the Australian Commonwealth on December 2nd last. Among the regulations which are still to be enforced are those relating to companies, firms and businesses. The protection of commerce and industry from undesirable outside influence is to be continued. If without the consent in writing of the Treasurer of the Commonwealth, any person seeks to secure the registration of any company or firm, or any change in any firm or company already registered, if such firm or company has partners who are not natural-born British subjects, that person commits an offence. The same applies to the person who seeks to register in Australia any foreign company or any firm or company with foreign capital. In other words, Australian industries are to be guarded against the free entry of non-British firms and money. Agents of overseas companies and firms are required to supply special annual returns within three months of the commencement of the Act, and those subsequently appointed, within one month of their appointment or arrival in Australia.—*Board of Trade Journal.*

Lead.—Messrs. James Forster & Co., reporting under date February 12th, stated:—"Closing prices yesterday were £21 10s. for February and £22 for May, against £22 15s. and £23 5s. respectively at the end of last week, representing a loss of 25s. on the week. Each day has seen a fall in values, and prices closed yesterday at the lowest. . . . . The metal certainly looks cheap at present values, but the general sentiment seems to be that prices will go still lower unless a much more active demand from consumers is forthcoming, and that lead, like other metals, is still largely influenced by the financial position is evidenced by the fact that a fairly large arrival of the metal at once had a depressing effect on values."

Trade-Union Rivalry.—According to the *Sheffield Independent*, last week's discussions at York between representatives of the craft unions in railway workshops have practically led to a severance of relations between the N.U.R. and the Shipbuilding and Engineering Federation of Trade Unions. The Central News Agency states that the craft unions have definitely decided that in no case will they permit their skilled members in a railway workshop to be members of a general industrial union such as the N.U.R.

Electrical Supplies in South Africa.—The *S.A. Mining and Engineering Journal*, of January 22nd, says that dealers in electrical goods report business generally as very slack. The shortage in gasfilled lamps has not yet been relieved. Consignments of electrical materials are coming in well, and prices show a tendency to go down slightly. Plenty of Continental goods are arriving, and although these are very much cheaper than British wares, the tendency of the former is to go up, while the price of British goods remains more or less stationary. Continental electrical materials are rising to-day.

Bennis Contracts.—The following are among the contracts that have been placed with Messrs. Ed. Bennis & Co, Ltd, during the past two months:—

Sunderland Corporation Electricity Works, Dunning Street, Sunderland.—Six chain grate stokers, with coal-elevating plant for Woodeson water-tube boilers.

Wimbledon Electricity Works, Durnsford Road, Wimbledon.—Four chain grate stokers for spearing water-tube boilers; ash elevating plant.

Metropolitan Railway Co., Power Station, Neasden.—Twelve chain grate stokers, adapted for forced draught, for Thompson's water-tube boilers (repeat order).

Guest, Keen & Nettlefold, Ltd., for Power Station, Dowlais (per Angus Scott & Partners, Ltd.).—Complete mechanical coal and ash-handling plant, including rotary truck tippler; rotary chain conveyor; six "Bennis" automatic boiler elevators; six automatic "Avery" coal weighing machines; ash hoist.

New Italian Companies.—There has been formed at Bergamo the Società delle Alte Valli Bergamasche, with a capital of 1,000,000 lire, for the production and distribution of electrical energy.

With a capital of 2,000,000 lire, Mecciche, De Vecchi e Ca., Società Elettrica Agrigentina, have been embodied a company at Girgenti for the production and distribution of electrical energy.

There has been launched at Lecce the Società Elettrica Industriale S.E.I., with a capital of 480,000 lire, for the production and distribution of electric light and power.

With a capital of 375,000 lire, Ing. Granda, Rabossi e Ca. have been registered a company at Milan with the object of trading in electrical material and insulated conductors.

There has been formed at Milan L'Italia, Società Anonima Riscaldamenti Elettrici Industriali S.A.P.R.I., for the manufacture of electric heating appliances. Capital 750,000 lire.

The Ora Elettrica, Società Anonima Orologi Elettrici has been launched at Milan (Via Borromei 9), for the installation of electric clockwork for all purposes. The capital is 300,000 lire.

A new company has just been formed at Borgosesia, Italy, with a capital of three million lire, and the title La Società Hidro-Elettrica de l'Arogna.

Water Power of Rumania.—A pamphlet on this subject in Rumanian, and a translation of the more important passages, together with a small map, may be inspected by United Kingdom firms interested on application to the Inquiry Room, Department of Overseas Trade, 35, Old Queen Street, Westminster, S.W. 1.

An Anti-Trade-Union Policy.—The *Daily News* states that the Association of Engineering and Shipbuilding Draughtsmen is protesting against the action of a number of firms in adopting superannuation schemes which contain a clause that the participating employés must not be members of a Trade Union. A movement is being organised with the object of persuading technical and other workers not to participate in any scheme which contains this prohibition.

British Branch Works for Canada.—A meeting of the British Empire Producers' Organisation will be held at the offices, 3, 5 & 7, Old Queen Street, S.W. 1, to-day, Friday, at 4 p.m., at which the chairman of council, Mr. Ben H. Morgan, will preside, and an address will be given by Mr. F. W. Field, H.M. Trade Commissioner in Toronto, on "Canadian Industrial Development and the Establishment of Branch Works in the Dominion." Anyone interested in Canadian affairs will be admitted on presentation of his card.

Book Notices.—"*Mechanical World* Electrician's Pocket Book, 1921." Manchester: Emmott & Co. Price 2s. net.—Among the important improvements made in the present issue of this handy work of reference is a lengthy section on motor starters and controllers. The previous matter has been rewritten and considerably extended. Other sections which have been rewritten and extended are those dealing with transmission conductors and cables, wiring systems and methods, and electric lifts. The section on electric heating and cooking has been added to. Another addition is a list of the principal abbreviations used in the volume.

Bibliotheca Chemico-Mathematica. A catalogue of works in many tongues on exact and applied science, with a subject index. Compiled and annotated by H. Z. and H. C. S. In two volumes; pp. xii + 964, and 127 plates. London: Henry Sotheran & Co. Price £3 3s. net.—This remarkable catalogue was begun in 1906, and has been growing ever since; by the time the end of the alphabet had been reached so much more material was available that a supplement was begun, which eventually exceeded the original scheme in size; and when that was done, a final supplement was added, and the whole was indexed (the index alone occupies nearly 100 pages). It is claimed that this work is the first historical catalogue of science published in any country, giving the price of each book and many other particulars. It is, as a compiler's preface claims, of very considerable human interest, and constitutes a very valuable addition to the bibliographic literature available to the scientific worker, embracing the whole field from the Middle Ages almost to the present day. The reproductions of plates and pages from ancient volumes are exceedingly interesting, full of quaint notions and ingenious devices, and—some of them—calling to our minds feelings of profound reverence for the triumphs of our forebears. We have before us, for example, the title-page of the first issue of the first edition of Newton's "Principia," published in 1686—fittingly described by the compiler as "the greatest work on exact science ever published." We have not space to linger over the literary and scientific riches of this catalogue, but we must offer our hearty congratulations to the compilers and publishers on the completion of a work of the greatest value to the scientific world.

"The Electrical Contractor's Year Book for 1920-1921." London: The Electrical Contractors' Association. Price 2s. 6d. The new features of the present issue of this handbook include notes on the constitution and functions of the National Joint Industrial Council and District Councils for the Electrical Contracting Industry, and a memorandum of agreement between the N.F.E.A. and the E.T.U., August 7th, 1920. The working rules for the various districts have been amplified and brought up to date. The frontispiece is a portrait of Mr. P. Collinson, President of the Associations.

"*Transactions* of the Illuminating Engineering Society." Vol. XV, No. 9. December 30th, 1920. 880 pp. Easton (Pennsylvania): The Society.—Part I of this volume deals with the activities of the various sections of the Society, and gives the *personnel* of Councils and Committees. Part II embodies a number of papers of great value and diversity, including papers on "Recent Applications of Colour in Lighting," "An Improved Method for the Illumination of Motion Picture Theatres," "Measurement of Reflection Factors" and "Some Applications of the Photoelectric Cell to Practical Photometry."

"Hydro-Electric Development in Ontario." By E. B. Biggar (202 pp.). Ontario: The Biggar Press, Ltd.—This volume is an historical survey of water power administration and development under the Hydro-Electric Power Commission of Ontario. After a dissertation on public ownership generally of public utilities and roads, the author gives a number of interesting facts regarding water power in the Dominion and the United States. Then the history of the Commission and its work is traced step by step, showing a vast amount of energy and enterprise. The public life and achievements of Sir Adam Beck, the chairman of the Commission, form a chapter, and an appendix describes the laboratories, shops and inspection departments, with details of the conditions under which leases are granted, and a section dealing with future developments. A financial summary and a bibliography are also included.

The Bulletin of the Hydro-Electric Power Commission of Ontario. Vol. VII, No. 9. November, 1920. (36 pp.).—This number contains articles on the purchase of the Toronto Power Co. and its subsidiaries by the Commission, with a description of the plants and transmission systems; also illustrated notes on the new Nipigon power development, and "Hydro Power in the St. Lawrence District."

Proceedings of the Fourth Convention of the South African Association of Municipal Electrical Engineers, Pretoria, 1920. (76 pp.). Pretoria: Buckley & Van Duyn.—This gives a full account of the meetings and reports, as well as the President's address, and regulations framed by the Convention.

Scientific Paper No. 404 of the U.S. Bureau of Standards, "Magnetic Reluctivity Relationship as Related to Certain Structures of a Eutectoid-Carbon Steel." (19 pp.) Washington: Government Printing Office. Price 5 cents.—Records of experiments carried out upon samples of steel under various heat treatments.

"Automotive Engineering." Part 1. February 15th, 1921. (12 pp.) London: The Standard Air Press, Ltd. Price 6d. net.—This is the first of a series of 26 fortnightly issues of a publication designed to supply the latest data bearing on all branches of automotive engineering. The present number contains notes on the compression and expansion of gases, the design of laminated springs, materials, &c.

"The Metropolitan-Vickers Gazette." Vol. VI, No. 94. January, 1921. (24 pp.) Price 1s., post free.—This issue contains, *inter alia*, articles on "Testing Equipment for Large Electrical Machines," by E. P. Hill, B.Sc.(Tech.), A.M.I.E.E., and a reprint from the *Electrician*, "Comparison of Welsh and American Practice in Electrically-driven Tin Plate Rolling Mills," by W. E. Taylor. The index to Vol. V is issued with this number of the "Gazette."

"An Introduction to Technical Electricity." By S. G. Starling. Pp. xii + 182; figs. 158. London: MacMillan & Co., Ltd. Price 3s. 6d.

"Small Single-Phase Transformers." By E. T. Painton. Pp. x + 96; 40 figs. Price 2s. 6d. net.

"Elementary Principles of Continuous Current Armature Winding." By F. M. Denton. Pp. x + 102; 44 figs. Price 2s. 6d. net. London: Sir I. Pitman & Sons, Ltd.

A Bradford Exhibition.—The Bradford Corporation electricity department has a big display of electrical apparatus at the Bradford Grocers' Exhibition now being held. Among the appliances shown are vacuum cleaners, electric washing machines, toasters, cooking and heating apparatus, coffee grinders, meat mincers and electrically-driven sewing machines. The display of indirect and semi-indirect electric lighting also is very pleasing and interesting. The stand is one of the most attractive in the exhibition.

The Cuban Market.—The *Electrical Review* of Chicago states that, owing to the increasing use of electricity and the comparatively slight development of the electrical market in Cuba, the island presents an important field for the sale of electrical appliances and fixtures of all kinds. The elimination of German rivalry has left the United States practically sole occupant with a firmly established footing. There are practically no electrical manufacturers in Cuba, and only a few minor concerns make chandeliers and drop lights, which are in great demand.

Italian Workmen Directors.—Signor Giolitti, on February 8th, presented to the Chamber a Bill for the supervision of industries by workmen's committees of nine members elected by the workmen for three years. The preamble defines the objects of the Bill, to give working men a knowledge of how industries are worked, to improve their technical education, ensure the application of the Factory Acts, and to ameliorate methods of production and the relations between Capital and Labour.—*Morning Post.*

Babcock Works in Australia.—Messrs. Babcock and Wilcox have purchased 20 acres at Regent's Park, New South Wales, on which they intend to erect a boiler-making and engineering factory, costing £100,000. A thousand men will ultimately be employed.—*Reuter's Trade Service* (Melbourne).

Fire.—The contents of the electrical fittings shop at Messrs. Henry Bessemer & Co.'s Forge, Bolton, were destroyed by a mysterious fire on February 9th.

South American Trade.—We have received from the London and Brazilian Bank, Ltd. (London), a copy of its quarterly trade reports (No. 12) from South America and Portugal, to January, 1921.

LIGHTING AND POWER NOTES.

Aberystwyth.—Change of Ownership.—At a meeting of the Town Council on February 8th, a letter was received from Mr. Holroyd, owner of the Pier, asking for the formal consent of the Council to the proposed purchase, by the writer, of the undertaking of the Aberystwyth and Chiswick Electricity Supply Co., which supplies lighting and power to the town. The matter was considered in committee.

Aberdeen.—Street Lighting.—Owing to the excessive cost of electric light standards, the Lighting Committee is experimenting with lamps suspended from overhead wires. If satisfactory results are obtained, King Street is to be illuminated in this manner for a great part of its length.

Ammanford.—Purchase of Undertaking.—After protracted negotiations, the Urban Council has finally purchased the Ammanford Electricity Supply Works from its owner, Mr. W. Herbert, at the figure of £14,375. The Council is now applying for an order enabling it to generate and distribute electricity within its area.

Australia.—The Morwell Power Scheme.—Two Bills were placed before the Victorian Legislative Assembly on December 14th last. The first provided for the raising of a second loan of £1,430,000 with which to carry out the Morwell (brown coal) power scheme. The capital cost of the scheme, which aims at a plant capacity of 45,000 kW, is estimated at £1,766,029, excluding terminal stations; the latter will cost another £230,000. It is proposed to supply power to areas at a maximum distance of 250 miles. The second Bill dealt with the constitution of the Electricity Commission, on which it was proposed to appoint General Sir John Monash, chairman, to be assisted by the three then existing Commissioners.

Tasmania.—Mr. J. H. Butters, chief engineer and general manager of the Tasmanian Hydro-Electric Department, has submitted his report for the year ended June 30th last. The accounts record a total revenue of £60,575. Working expenses and capital charges amounted to £55,179, leaving a balance carried to depreciation suspense account of £5,396. About £3,000 was made by the Operations Branch, and the balance by the Hobart District Branch, which is considered satisfactory. Work on the Great Lake Dam has been held up on account of the delay in delivery of the necessary cement, but it is hoped to bring the dam up to the 20-ft. level during the present summer, and to complete it by next summer. The Waddamana Canal has been widened, and the work is expected to be completed in proper time. The Risdon sub-station has been designed, and the plant is on order. Time lost during the war has been partly made up for in the amplication of the Hobart distribution system, and the route for the Launceston transmission line has been laid out and clearing has started; a specially-designed steel tower is being employed on this line. Difficulty has been experienced in finding a suitable site for the Arthur's Lakes dam, but the problem has now been solved, and tenders are being invited for the construction of the dam. During the year it was found necessary to increase substantially the salaries of some of the officers, as it was found that in many cases the men working under them were receiving higher rates of pay.

Barnsley.—Loan Sanctioned.—The Town Council has received permission to borrow £14,200 for electricity purposes.

Barrow.—Loan Sanctioned.—The Electricity Commissioners have forwarded formal sanction to the borrowing of £35,000 for the purposes of the electricity undertaking, on the understanding that actual details of the expenditure will be furnished in due course, and so far as the item of £2,500 for radiators is concerned, on the condition that the total sums expended and received, including interest and sinking fund, shall be shown separately in the published accounts each year.

Canada.—Extensions at Winnipeg.—The Chief Engineer of Winnipeg has contributed to the *Electrical News* some interesting details of the extensions being carried out to the city's electrical undertaking. The original installation consisted of five hydraulic turbo-generators, each of 5,200 h.p., with two 400-h.p. exciters and two banks of transformers each of 9,000 kW capacity. Later, three 6,800-h.p. machines and one 9,000-kW three-phase transformer were installed. In 1920 the contract was let for the completion of the power house building, consisting of an extension to the generator room 268 ft. long, 63 ft. wide and 80 ft. high. This extension will house eight 7,000-h.p. units, two 18,000-kW transformer banks and the necessary switchgear and controlling apparatus. The completed building will then house a plant having a capacity of over 100,000 h.p. The estimated cost of the present extensions is $300,000.

Continental.—Switzerland.—The Commercial Secretary to H.M. Legation at Berne states that there are now in operation in Switzerland 16 power stations which produce a minimum of 20,000 h.p. The Löntsch Works (Glaris), recently enlarged, is the greatest power producer, but owing to the irregularity or excessive diminution of water pressure at certain times its production is stayed considerably for some months in the year. It is equipped for an output of 66,000 h.p. The control exercised by the State is inconsiderable, and there has been no unity of direction in the consideration of water-power schemes, which have been taken in hand by the railways, by cantons, towns, or industrial groups (or by combinations of one or more of these). An official summary shows that there is approximately 4,000,000 h.p. available, of which only about 720,000 h.p. is being utilised. According to these figures only 18 per cent. of Swiss potentialities in this sphere had been realised up to the close of 1919. Since the commencement of 1920 the increased power obtained represents, perhaps, another 2 per cent., so that there remains approximately 80 per cent. of Swiss water-power capacity to be turned to account.—*Board of Trade Journal.*

France.—A new agreement is proposed between the Paris Municipal Council and the Compagnie Parisienne de Distribution d'Electricité for the purpose of ensuring the most economical working of the latter's undertaking in the general interest. The scheme also aims at the reduction of the prices to 0·85 fr. per kW-hour in the first place, and eventually to the pre-war charge, 0·70 fr. per kW-hour.

Norway.—The Commissions appointed by the Norwegian and Danish Governments to study the question of the transmission of electricity from Norway to Denmark have held their first joint meetings, and discussed the bases of further co-operation.—*Reuter's Trade Service* (Copenhagen).

Greece.—On February 6th the tramway and gasworks employés ceased work, and on February 10th were joined by the men of the electric power works and the Athens Piræus Railway. The Govern-

ment were threatened to mobilise the strikers if the terms offered them were not accepted.

The strikes were finally ended by the intervention of the King, who championed the cause of the strikers.

Doncaster.—Loan Sanctioned.—The Electricity Commissioners have sanctioned the borrowing of £8,665 for the provision of transformer equipment, mains and services for the Carr House Estate.

Dorchester. — Purchase of Undertaking.— It is reported that the draft agreement whereby the Council is to purchase the local undertaking of the Dorset Electric Supply Co. has been approved by the Lighting Committee. The Council is to take over the books of the company and all contracts if these are found to be fair. It is expected to complete the transfer by June 1st next, and sanction is being sought to borrow £16,000. for the purpose.

Dunblane.—Electricity Supply.—The Town Council has assented to an order being obtained by a local company for the purpose of providing a supply of electricity for the town, on condition that the Council does not waive its rights to grant powers to another company, or to apply for an order itself.

Ealing.—Electricity and Housing.—It is compulsory for all tenants of the new local municipal houses to use only electricity for lighting purposes.

Eton.—Supply by Overhead Cables.—The Rural District Council has consented to the extension of the overhead cables to Farnham by the Slough and District Electric Supply Co., by which electricity will be supplied to the parish.

Fareham.—Year's Working.—The accounts of the electricity undertaking for the year ended March 31st last show a total income of £3,427 and working expenses amounting to £2,977, leaving a gross profit of £450. Capital charges, with a debtor balance from the previous period, absorbed £1,566, leaving a net deficit of £1,116.

Guisborough (Yorks.).—Bulk Supply Approved.—The Urban District Council has decided in favour of obtaining a supply of electricity in bulk from a power company, and the clerk has been instructed to ascertain the cost of an order to distribute a supply in the area.

Harrogate.—Loan, &c.—The Town Council decided on February 8th, at a special meeting, to oppose the Harrogate Gas Co.'s Bill which is being promoted in Parliament. The Council has resolved to apply for sanction to borrow £2,500 for electric lighting services, and a like amount for transformers; it was also decided to ask for sanction to borrow £39,486 for extensions to the electricity works generating plant.

Heywood.—Minimum Charge Increased.—The Town Council has confirmed a proposal of the Electricity and Tramways Committee to increase the minimum charge for any consumer of electricity from £1 to £2.

Huddersfield.—Extension of Area of Supply.—The Corporation is applying to the Electricity Commissioners for a special order authorising it to extend the supply of electricity to the urban districts of Kirkheaton, Lepton, Kirkburton, Meltham, and Slaithwaite.

Hull. — Extension of Supply Area.— A special meeting will precede the March meeting of the City Council to consider the propriety of applying to the Electricity Commissioners for a special order authorising the Corporation to supply electricity at Anlaby, North Ferriby, Melton, Welton, Swanland, Willerby, Kirkella, and Westella.—*Eastern Morning News.*

Ilford.—Claim Against Corporation.—An Ilford firm is claiming damages from the District Council owing to the failure of the Council to supply electric power to the firm's factory during the recent strike.—*The People.*

Ilkley.—Extensions.—At a recent meeting of the Council a letter from the Electricity Commissioners was read, desiring that the extensions being carried out at the electricity works should be confined to the minimum necessary for the housing of a 170-kW set, for which a loan was sanctioned last year. This is in consequence of the negotiations with the Keighley Corporation for a bulk supply; the Commissioners do not wish further extensions to be made if a supply can be arranged to meet adequately the needs of the town.

Keighley. — Extension of Supply. — A contract has been entered into between the Craven and District Private Telephone Co., Ltd., and the Keighley Corporation for the supply of electricity at 6,600 V from Keighley to Eastburn, for the purpose of supplying Messrs. Dixon's stone quarries, near the latter village. It is understood that eventually the system will be extended to the village itself, as well as to Steeton, Silsden, and Crosshills.

Kingston-on-Thames.—Price Increase.—The decision of the Corporation to increase the charge for electricity for lighting from 8d. to 1s. has received the sanction of the Electricity Commissioners. The fact that the increased charge is retrospective to September has called forth a storm of protest from all classes of consumers, and many meetings have been held.

London.—Hammersmith.—The Finance Committee of the London County Council has been informed by the Electricity Commissioners that the Hammersmith Borough Council wishes to borrow £174,000 for extension of generating plant, and the Commissioners ask for the London County Council's observations upon the question of the outstanding debt on the plant to be displaced. Five old generating sets are to be scrapped, and a large second-hand set is to be purchased in lieu of them, the balance of cost being met from revenue account. The Council has replied that there is no financial objection to this course provided that if the estimated life of the second-hand set is less than the outstanding period for the repayment of the existing loans on the sets to be sold, the repayment period be correspondingly reduced.

With reference to the bulk supply of electricity which the Council agreed to furnish to the Chiswick Electricity Supply Corporation, Ltd., for general purposes, in addition to that taken by it for a supply to a factory in its area, for some time past, negotiations have been in progress with the Electricity Commissioners. The town clerk and the borough electrical engineer recently attended before the Commissioners in order to consider representations submitted by the Metropolitan Electric Supply Co., Ltd., to the effect that it was the proper authority to give the supply, and that, consequently, the agreement should be terminated upon the expiration of three years. After hearing the arguments of both sides, the Commissioners approved the draft agreement submitted to them, with the addition of a proviso relating to the maximum demand.

Hackney.—The accounts of the electricity undertaking for the year ended March 31st last record a total income from all sources of £118,572, as compared with £115,883 in the previous year. Working expenses totalled £76,163, as against £67,805, leaving a gross profit of £42,409 (£48,078). Loan charges, bank interest, and other payments amounted to £39,707 (£38,469), and the result was a net profit of £2,754, a considerable decline from the previous year's figure—£9,609. The number of units generated and sold fell from 16,217,325 to 14,774,198. The closing down of the National Projectile Factory deprived the undertaking of a very valuable bulk load. This would have been replaced by ordinary consumers but for delays in the provision of new mains and sub-station plant.

New Zealand.—Local Supply Authorities.—The *Commonwealth Engineer* reproduces statistics regarding local authorities' electricity undertakings from the report of the Chief Electrical Engineer of the Dominion. The figures show that more than half of the total plant capacity is hydro-electric in character. The exact figure is 23,998 kW, or 52·4 per cent. Steam plant is next in order with a capacity of 16,122 kW, or 35·2 per cent. The dominant system of supply is a.c. three-phase, 50 cycles, representing 58·3 per cent. of the whole, while the d.c. three-wire system at 460 volts constitutes 24·6 per cent., leaving but a small proportion of non-uniform supplies at various frequencies. In these circumstances it is not surprising that the three-phase 50-cycle system has been adopted as a standard to which all future developments will conform. In two years' time it is estimated that 75 per cent. of the installed plant will be of this type. It is stated that out of 55 plants, 27 were operating at a profit after payment of capital charges, and to remedy the condition of the balance of the plants, economy in operation, increased output and higher charges are recommended. The load factor and output are higher in the South Island owing to the cheaper cost of production. The average cost per unit sold is 1·3d. in the South Island, and 2·4d. in the North.

Lake Coleridge.—The annual report upon the Lake Coleridge hydro-electric undertaking shows that the total revenue rose from £37,324 to £45,831, representing an excess over all charges of £3,585, which is the first credit balance for five years. The total connected load increased from 23,992 kW to 30,854 kW, and the highest simultaneous load reached 7,066 kW—an 18 per cent. overload.

Nottingham.—Temporary Station.—To meet immediate needs while the large station at Clifton is being erected, the Council has decided to provide a temporary station, with a capacity of 4,000 kW, on the site, at a cost of about £50,000.

The Colwick Park Estates Co. recently applied to the Electricity Commissioners for permission to erect a power station of its own, but the Commissioners requested it to approach the Corporation with a view to obtaining a bulk supply. The Corporation is accordingly asking for powers to extend its area of supply to the Colwick Park Estates and other districts which it is deemed desirable to include.

Perth.—Extensions.—As a result of the inquiry by Col. Ekin, the Electricity Commissioners recommend the early installation of a 1,000-kW generating set, and that the question of a new boiler be considered as well. The Electricity Committee has accordingly requested the Town Council to apply for sanction to a loan of the necessary amount to carry the recommendations into effect. The electrical engineer estimates the requirements at between £40,000 and £50,000.

Rochdale.—Electricity in Sanitary Department.—In connection with the Corporation's application for sanction to borrow £19,500 for installing plant and effecting improvements at the sanitary works, the superintendent's proposals include the provision of an electrically-driven aerial runway or ropeway for the conveyance of ash and clinker, at a cost of £5,000, an enclosed high-speed engine coupled to a 100-kW dynamo, and motors, at an estimated cost of £4,500.

St. Andrew's.—Price Increase.—Regarding a recent inquiry at St. Andrew's into the application by the Electric Supply Corporation for an increase in the lighting charges, it was stated at a Town Council meeting that were the increases allowed, St. Andrew's consumers would be called upon to make up the deficit in other places where the company was not making a profit.

Sunderland.—Loan.—The Town Council is applying to the Electricity Commissioners for sanction to borrow £12,000, which is the amount estimated to be necessary to meet sub-station requirements upon capital account during the ensuing three years.

Wanstead (Essex).—Suggested Electricity Scheme.—The Urban District Council has referred to a special Committee the question of securing a supply of electricity for the town.

Warrington.—Breaking-up of Road.—In laying the necessary cables for a supply of electricity to the works of Messrs. N. Greening & Sons, the Electricity Department has found it necessary to open up a new road. The Paving Committee has objected to this, pointing out that before the road was completed, notices were sent to all departments likely to be affected to enable them to lay any pipes or cables that would become necessary. The chairman of the Electricity and Tramways Committee stated that Messrs. Greening had been approached at that time, but did not require a supply. The Corporation was bound to give a supply if it was able to do so.

TRAMWAY AND RAILWAY NOTES.

Blackpool.—Collision.—Two tramcars on the Blackpool to Fleetwood tramway route collided in the fog on February 9th. The fronts were damaged, but the drivers escaped with slight injury; several passengers complained of shock.

Bradford.—Inquiry into Accident.—The inquiry as to the cause of the recent tramway accident in the Idle Road district, in which a tramcar overturned and injured about 40 passengers, was held at Bradford on February 10th by Major Hall, R.E., of the Ministry of Transport. The testimony of the driver of the car, Fred Benson, was that the fog was so thick as to obscure the landmarks, and that he had lost his bearings when the car struck the points. The car was being driven at reduced speed because of the fog, and despite the application of the brakes, it continued its course off the rails until it struck a wall and overturned. The points were found to be in good order after the accident, as was also the car gear. The Inspector's report will be published in due course.

Burnley.—Track Renewals.—In view of the financial position of the tramway undertaking, the Committee has arranged to spread the work of relaying the lines over six years instead of three. Residents only are to be engaged on the work.

Chile.—Railway Electrification.—The Government has postponed the final date for sending in tenders for the electrification of the railways, in consequence of several British firms desiring to compete for the work.—*Reuter.*

Continental.—Italy.—Work is steadily progressing on the electrification of the railway system between Trieste and Pola. An electricity distribution system is also being established throughout the Bas-Ferranese and Bas-Polesine districts, with the object of substituting electricity for steam, particularly in connection with agricultural operations.

Cork.—Tramway Dispute.—The Corporation has passed a resolution approving of the appointment of a committee consisting of a representative of the Corporation, one of the tramway company, and one of the tramway men on strike, to investigate the demand for increased wages and arrange for a settlement, the strikers to resume work meantime at a 3s. a week increase.

Dublin.—Tramway Employes' Demand.—The employés of the Dublin Electric Tramways Co., Ltd., have ballotted on the question of a strike unless the demand for the 12s. increase was acceded to; 1,055 voted in favour, and 37 against. They have decided to withhold their notices, as the Ministry of Labour is intervening, and it is generally hoped that a satisfactory settlement will be reached.

Edinburgh.—Electrification of Tramways.—At a recent meeting of the Corporation, several motions urging the electrification of tramways were put forward. The routes which were selected for conversion were that from Hanover Street to Goldenacre, to join the Leith system, and that from Goldenacre to Queen Street.

Halifax.—Track Renewals.—It is estimated that there will be a loss on the tramway undertaking of about £9,000 for the present financial year. The effect of the increased fares has not yet been felt. A Sub-Committee recommends that the Tramways Committee should arrange for the renewal of the tramway track on several of the principal routes during the next three years. The cost of this will approach £200,000, and £90,000 of this may have to be included in the next financial year.

Hull.—New Track.—With a view to relieving the congestion in the centre of the city, the Tramways Committee after considering several schemes at a special meeting, has adopted one which will involve the laying of a double line along a portion of Jameson Street.

Lancashire and Yorkshire Railway.—The report for 1920 gives the following particulars:—Trains worked by electric power, 233, with 18,445 seats; electric traction mileage run, 2,254,421, against 1,968,058 in 1919. Estimated further capital expenditure on electric power stations, &c., £89,200; subsequently, £132,700.

Lancaster.—Accident Insurance.—The desirability of being adequately insured against third-party risks was demonstrated at the meeting of the Town Council, on February 9th, when it was agreed to pay £1,170 compensation to the widow and children of Thomas Stackhouse, a pedestrian killed by a runaway car on the Bowerham route, on September 27th, 1920. The policy only gave £500 in case of death and £2,000 for any one accident, so that the Corporation loses £670. It was pointed out that if 20 had been killed, the loss which would have fallen on the shoulders of the Corporation would have been about £18,000.

Liverpool.—Contract with L. & N.W. Railway.—The Corporation has renewed its agreement with the London and North-Western Railway Co. for the supply of electrical energy for a further period of 12 months.

London.—Report upon Arcing.—A Ministry of Transport Inspector has reported on the causes of the excessive electrical arcing which took place on the London Electric Railway on November 7th last between Piccadilly Circus and Oxford Circus stations. The train in question was composed of three trailer cars with a motor-car at each end. The arcing commenced under the front car, and gave rise to heavy fumes and smoke, and the train was brought to a halt in a tunnel, and passengers were transferred to another. Although nobody was seriously affected, several employés experienced ill-effects for some days afterward. It appears that the trouble was due to the fracture of the connecting cable of one of the shoes at a point where a metal sleeve connector had been fitted. It was admitted that this form of connection was unsuitable in character, and that all shoe cables in which the sleeve had been used were being replaced. On the same evening, fusing of a less serious character occurred on the same line, but in this case it was found to be due to the breaking down of the insulation of a negative shoe. The Inspector states that: "these two cases illustrate how rapidly atmospheric conditions in a tube, as the result of electrical fusing, become noxious, if not actually dangerous. Electrical pressure in such an emergency must, therefore, be removed at the earliest possible moment." The company is to be asked to state the results of experiments in connection with devices for a more direct interruption of the supply, in such cases, upon the section of line occupied.

Competition for Designs for New L.C.C. Electric Tramcars.—The report of Mr. A. L. C. Fell, the general manager of the L.C.C. tramways department, and Mr. J. P. Cronch, general manager Metropolitan Carriage and Wagon Co., Ltd., states that no one of the proposals submitted is of sufficient merit to justify serious consideration or adoption, nor does any design submitted offer any material improvement on the existing standard type of car from any point of view. There is also a conspicuous dearth of proposals in respect of the electrical equipment, and trucks or bogies; so much so that in the majority of cases, a complete lack of electrical and mechanical knowledge is apparent with regard to these most important features of car design. The assessors state that in their opinion the result of the competition is distinctly disappointing, in that nothing really new, and at the same time practical, has been suggested.

Hammersmith.—The L.C.C. has given the Borough Council sanction to borrow £788 for the provision of the necessary charging plant for the recently-purchased electric vehicles. The present cost of charging is 4d. a unit, and it is estimated that the price per unit will fall to 1½d. when the charging set is installed.

Newcastle.—Railway Electrification.—A correspondent of the Newcastle-upon-Tyne *Daily Chronicle* states that a start will be made shortly with the work of converting the main line between Newcastle and Darlington to electric traction, which will be extended later to York. This important project with which it has now been decided to proceed is only one of the several schemes for the improvement of the North-Eastern Railway services that are being considered.

Sunderland.—Parcel Transport.—The Sunderland District Tramways Co. has instituted a system of parcels transport from Sunderland to the villages in the district served by its cars. The scale of charges is:—Up to 7 lb., 3d. a package for any distance; 7 to 14 lb., 5d.; 14 to 28 lb., 7d.; and 28 to 56 lb., 9d. The Sunderland Corporation, over whose track the parcels are carried as far as Grangetown, will benefit financially by the scheme.

TELEGRAPH AND TELEPHONE NOTES.

Austria.—Cable Rates Doubled.—*The Times* announces that, as from February 15th, the rates for cable telegraph messages to all foreign countries, except those bordering on Austria, were doubled.

Germany.—Wireless Service to England.—A public wireless service between this country and Germany was begun early this month. The transmitting station on this side is at Stonehaven, Scotland, and the main telegraph office at Berlin acts as the German station. Messages handed in at Berlin are sent by wire to Königs-Wusterhausen, where they are automatically transmitted by wireless. The receiving station at Tetlow automatically transfers the messages to Berlin by wire. Telegrams are received between 5 and 8 p.m., the charges being the same as the cable tolls. —*The Times.*

Sweden.—Anglo-Swedish Wireless Communication. —*Dagensnyheter* learns that a new telegraphic route between Stockholm and Stonehaven, Scotland, will shortly be inaugurated. Telegrams will be sent by special wire from Stockholm to the wireless station at Karlsborg, whence they will be automatically transferred and transmitted by wireless.—*Rew'er's Trade Service* (Stockholm).

Telephone Service.—New Charges.—With regard to the new charges for telephone service, notices are being issued to terminate many yearly agreements three, six, or nine months before the course of the agreement has been run, and the P.M.G. states that subscribers will be entitled, in the event of a discontinuance of the service, to a rebate for the unexpired portion of the period.

U.S.A.—Cable Communication Conference. — The Cable Communications Conference, which adjourned last December, was to meet again on February 11th at Washington, says the *Morning Post*, at the instance of Mr. Davis, Acting Secretary of State and Chairman of the Conference. In the absence of Sir. Auckland Geddes, the First Secretary of the Embassy will represent Great Britain. The American Government is anxious that an agreement shall be reached before the present Administration goes out of office.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Aberdare.—March 4th. Urban District Council Electricity and Tramways Department. Stores for one year, including cable, meters, lamps, &c. (February 11th.)

Australia.—Melbourne.—March 2nd and 9th. Victorian Railways. Reactances and condensers (for power signalling), electric crabs and equipment for cranes.*

Brisbane.—March 30th. P.M.G.'s Department. Switchboard apparatus and parts.*

Belfast. — February 26th. Tramways Committee. —Tramway stores, including electrical accessories, cable, lamps carbon brushes, &c. (January 28th.)

Tramways Committee. Two 500-kW, 500/550-V converters. (See this issue.)

Belgium.—February 26th. The municipal authorities of Nil-Saint-Vincent (Province of Brabant). Establishment of an electricity distribution system in the town. Particulars may be obtained from, and tenders are to be sent to, La Maison Communale.

Croydon.—March 7th. Electricity Department. Two natural draught cooling towers. (See this issue.)

London.—H.M. Office of Works. February 21st. Supply of electric bell fittings for six months. (February 11th.)

March 2nd. Six or twelve months' supply of electric lamps. (See this issue.)

Camberwell.—February 28th. Libraries Committee. Installing electric light, &c., in the Central Library, Peckham Road, S.E. (See this issue.)

Manchester.—April 4th. Electricity Committee. 33,000 and 6,600-V switchgear, induction regulators, &c., for controlling sub-stations of large capacity. (See this issue.)

New Zealand. — Wellington. — March 1st. Public Works Tender Board. Seven 4,000-kVA single-phase transformers, with accessories, for Lake Coleridge electric power scheme.*

March 5th. Government Railway Department. Two overhead travelling cranes.*

Portsmouth.—Electricity Supply Department. Three 1,500-kVA Scott-connected transformer groups, 3-phase, 6,600-V switchgear. (February 11th.)

South Africa. — Pretoria.—March 10th. Municipal Council. One 20-ton overhead crane, six boilers (350-lb. working pressure), three 3,000-kW steam turbo-generators with condensing plant, five 750-kW converters. Further particulars can be obtained from Mr. T. C. Wolley-Dod, general manager, electric lighting department. Specifications (five guineas) from the town clerk.

May 3rd. S.A. Railways and Harbours. Plant for the electrification of the Cape Town-Simonstown and Durban and Pietermaritzburg Railways. (February 11th.)

Stockton-on-Tees. — February 28th. District Fund. Gas and Electricity Committees. Articles and stores for six months. (See this issue.)

Uruguay.—Monte Video.—March 29th. State Power House. Single and three-phase meters.*

March 31st. A telegram from H.M. Minister at Monte Video (Sir C. C. Mallet, C.M.G.), to the Department of Overseas Trade, states that general tenders are invited until March 31st for the construction of the projected port works at Paysandu, for which an expenditure of $280,457 30 has been sanctioned. The construction of a dyke, the acquisition of electrical handling and lifting apparatus, the extension of the mole and the construction of anchoring grounds, are included in the scheme.

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Belgium.—Six firms submitted tenders recently to the municipal authorities of Antwerp for the supply of a converter set and switchboard for the transformer station in connection with the No. 7 Canal Basin. The lowest offer was that of the Société de Constructions Electriques de Charleroi, which quoted alternative prices of 165,950 and 207,900 francs.

Sunderland.—Town Council. Accepted :—

Meters.—Ferranti, Ltd.

Wolverhampton.—Electricity Committee :—

Eight "A" type stokers and accessories, £2,093.- Underfeed Stoker Co., Ltd.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, February 18th. At the Institution, Storey's Gate, S.W. At 6 p.m. Annual general meeting. Paper on "Desirability of Standardisation in the Testing of Welds," by Mr. F. M. Farmer.

Junior Institution of Engineers.—Friday, February 18th. At 39, Victoria Street, S.W. Social evening.

Friday, February 25th. At Caxton Hall, Westminster, S.W. At 8 p.m. Lecture on "Measurements of Precision in Engineering," by Mr. H. T. Davidge.

Manchester Wireless Society.—Wednesday, February 23rd. At 7.30 p.m. At the Albion Hotel, Manchester. Lecture on "Aerials," by Mr. P. G. Thomason.

Paisley Association of Electrical Engineers.—Wednesday, February 23rd. At the Y.M.C.A. Buildings, 25, High Street. At 7.30 p.m. Paper on "Thermometry and Pyrometry," by Mr. J. Savage.

Chelmsford Engineering Society.—Thursday, February 24th. At the East Anglian Institute of Agriculture. At 7 p.m. Paper on "Engineering as Applied to Town Planning," by Mr. P. T. Harrison.

Illuminating Engineering Society.—Thursday, February 24th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 8 p.m. Discussion on "The Use of Light as an Aid to Publicity." (a) "Shop Window and Spectacular Lighting," introduced by Capt. E. Stroud; and (b) "Illuminated Signs, &c.," by Mr. E. C. Leachman.

Institution of Electrical Engineers.—Thursday, February 24th. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Lecture on "Magnetic Susceptibility of Low Order: Results of Scientific Research" (Lecture II.), by Prof. E. Wilson.

(Students' Section).—Friday, February 18th. At King's College, Strand, W.C. At 6.30 p.m. Presidential address, by Mr. Ll. B. Atkinson.

North-Midland Centre.—Tuesday, February 22nd. At the Hotel Metropole, Leeds. At 7 p.m. Ordinary meeting.

North-Western Centre.—Tuesday, February 22nd. At the Engineers' Club, Manchester. At 7 p.m. Paper on "Magnetos for Ignition Purposes in Internal Combustion Engines," by Mr. E. A. Watson.

South-Midland Centre (Students' Section).—Tuesday, February 22nd. At the University, Birmingham. At 7.30 p.m. Paper on "Turbo-alternators," by Mr. J. P. Ellis.

South-Midland Centre.—Wednesday, February 23rd. At the University, Birmingham. At 7 p.m. Discussion on "Electric Appliances for Domestic Purposes." To be introduced by a paper by Dr. E. Griffiths and Mr. F. H. Schofield on "Some Thermal Characteristics of Electric Ovens and Hot Plates."

Edinburgh Electrical Society.—Friday, February 25th. At the Philosophical Institute. At 8 p.m. Paper on "Telephone Troubles," by Mr. J. McEwan Brown.

Physical Society of London.—Friday, February 25th. At the Imperial College of Science, South Kensington. At 5 p.m. Ordinary meeting

NOTES.

The King's Speech.—In the speech with which His Majesty the King opened the Parliamentary Session of 1921, on Tuesday, reference was made to a Bill which will be introduced for extending the provision made for the unemployed under the Unemployment Insurance Act; a measure to deal with the safeguarding of essential key industries of the country and with certain aspects of unfair and abnormal industrial competition. "It is proposed that the forthcoming removal of control over the home price and export quantities of coal shall be followed at the earliest possible moment by the complete restoration of the industry to its normal condition of freedom." A Bill will be submitted for the reorganisation of the railways of Great Britain.

Smoking Concert.—The L.E.E.O.C.A. is holding a smoking concert at the Bridge House Hotel, London Bridge, on Friday, March 4th, at 6.30 p.m. Admission by membership card only. Mr. F. Frankling (hon. sec.), 108, Heathwood Gardens, Charlton, S.E. 7.

Running Costs of Electric Vehicles.—A correspondent to *The Commercial Motor* protests against what he describes as "glaring exaggeration" on the part of a contributor in an article on the running costs of electric vehicles. He asserts that full justice has not been done to the "electric" in comparing it with other means of road transport, and quotes figures of "definitely attained results" to show that the advantage of the electric vehicle over the petrol vehicle is much more marked than the contributor of the article admitted. The correspondent first takes the case of a large railway company, and compares two 1-ton vehicles—petrol and electric. The fuel in the case of the former cost £83 per year (3,000 miles) and the energy for the electric vehicle £20. The next item is attested by the borough surveyor of Gillingham. Comparing two vehicles of 5-cb. yards capacity employed in the collection of refuse, the petrol type cost £17 4s. 8d. per week, as against £12 6s. 10d. for the electric. The third case is a comparison of a 1-ton petrol vehicle and a 15-cwt. electric, carrying approximately equal loads, in the service of a "well-known firm of contractors, Lancashire." With an annual run of 5,000 miles, the cost of the petrol vehicle was about 10s. per day in excess of that of the electric vehicle.

Service Notes.—Lieut. A. C. Box, from the City of Edinburgh Fortress Royal Engineers (Electric Lights Company) has been appointed in the same rank to the Territorial Reserve of Officers, from the 9th inst.

Recruiting for electrical departments of both the Army and Navy is very good, but additional electricians are needed for wireless work and Royal Air Force.

Lieut. A. C. Petherwick has been appointed to H.M.S. *Jumna*, Bombay, to take charge of the wireless station at Colombo, Ceylon.

Electric Industrial Truck Taxes.—The Electric Vehicle Committee some little time ago, as reported at the time in our columns, obtained a statement from the Roads Department of the Ministry of Transport that it would not be necessary to take out licences for electric industrial trucks in cases where these little vehicles were used to cross or only run a short distance along a public highway from one factory to another where both factories were in the same ownership. The Ministry stated that if necessary it would issue instructions to the Treasury regarding this matter. The Electric Vehicle Committee having found that in many cases the local authorities were insisting upon licences being taken out for such vehicles, the Committee has again taken the matter up very strongly with the Ministry, and has at last received a letter which states that no steps will be taken by the police or registration authorities to enforce the requirements of the Acts for the time being, and accordingly it is hoped that the owners of electric industrial trucks will have every opportunity of submitting the facts relating to their vehicles for consideration by the Ministry without being put to any inconvenience by the police or registration authorities in the meantime. It was found to be impracticable to deal with cases of this character by legislation or by regulations, and the Minister undertook to consider whether cases of this character could be dealt with in administration. He, therefore, requests Councils, should any such cases arise within their area, to verify and furnish to the Ministry particulars of the vehicles and the extent to which they use public roads, and he further suggests that, pending consideration of this report by the Minister, Councils should not take any steps to enforce the taking out of licences by the owner.

The Electro-Harmonic Society's Concert.—The concert provided on Friday last (Ladies' Night) calls for special mention as one of the best that the Society has ever enjoyed. Captain R. J Wallis-Jones, O.B.E., T.D., was in the chair, and pointed out that the chairs in the parks were not the only things that had not "gone up"—the Society had not put up its subscription (but can it hope to maintain that generous policy?). From the start things went with a swing; the opening solo, by Mr. Bernard Flanders, was enthusiastically encored, and the same compliment was paid to all the other artistes—some, indeed, being twice recalled. Miss Violet Oppenshaw was at her best; Mr. Wilson James was really humorous; and of the combination of cornet, concertina, and piano, by Messrs. Lloyd Shakespeare and Ernest Rutherford, and Miss Gladys Millage, the audience never had enough; the chairman had to point out that time would not permit of further recalls. Altogether it was a gala night.

Educational.—Polytechnic, Regent Street (Electrical Engineering Department).—A special course of six lectures by Mr. D. J. Bolton, on "Electricity Control," will be given on Friday evenings, commencing on February 25th, at 7.45 p.m. Fee for the course, 7s. 6d. See our advertisement pages to-day.

Messrs. George Wills and Henry Wills, directors of the Imperial Tobacco Co., who gave princely sums towards founding the University of Bristol, have just contributed a further £200,000 to finish the substantial extension which is being erected entirely at their expense, and the completion of which, it is stated, will place the University buildings of Bristol among the finest in the country, apart from Oxford and Cambridge.—*Financial Times.*

Fatalities.—George Smith (29), mining machineman, Gartsherrie, Coatbridge, received fatal injuries while working at a coal-cutting machine in No. 10 Rosehall Colliery, owned by Robert Addie & Sons' Collieries, Ltd. His leg accidently came in contact with the picks attached to the coal-cutting bar, and he was dragged under the bar.

According to the *Dundee Advertiser*, a sudden stoppage of electrical power on a part of the Glasgow Corporation's system caused a fatal accident. In the Fairfield shipyard a heavy piece of work was being lifted by an electric crane, and when the power was cut off the load fell among some workmen, causing instantaneous death to one of their number.

Joint Electricity Authorities.—On Tuesday last the inquiry into the schemes proposed for the North Wales and Chester district was opened at Llandudno by the Electricity Commissioners. Sir John Snell presided, and Mr. J. H. Dickson, Town Clerk of Chester, made a statement with regard to the scheme developed by the Chester Corporation (summarised in our issue of Jan. 14th), explaining that it was not proposed that the Joint Electricity Authority should buy out any existing generating station or interfere with the North Wales Power Company. It was held that the transmission of electricity from the west to the east of the area was out of the question, but the demand in the east was very urgent. The Corporation, therefore, proposed to erect a steam power station on the Lower Dee, to work in conjunction with water power stations on the Upper Dee, to meet the demands of the east. Eventually the eastern and western networks would meet and be interconnected. Mr. Dickson then referred to the attitude of various local authorities towards the scheme, there being a good deal of opposition.

Evidence was heard in favour of the Chester scheme, the first witness being Mr. E. N. Humphreys, of Chester, who was cross-examined by Mr. Harper for the North Wales Power Company; Mr. Tyldesley Jones, K.C., for the railway companies; Mr. A. Moon, for the Dee Conservancy Board; and Mr. W. O. Jones, clerk to the Anglesey County Council.

On Wednesday morning Mr. Humphreys was further cross-examined by Mr. W. Fennell, engineer and secretary of the Northwich Electric Supply Co., the representative of Rhyl Urban District Council, and the Commissioners. In the afternoon Mr. S. E. Britton, electrical engineer to the Chester Corporation, gave evidence.

The inquiry proceeded on following days, and will be reported in our pages in due course.

The inquiry at Liverpool is to be resumed on March 8th. The adjourned Bristol inquiry will not be resumed, as anticipated, on March 1st.

Electric Power Development.—In an article under this heading, a correspondent of the *Financial Times* points out that the development of electric power, which is of paramount importance to our industries, is at a standstill, the whole country having to wait upon the wholly problematical issue whether joint electricity authorities can be formed.

There are now 13 districts delimited by the Electricity Commissioners, and all of these are supposed to be at work forming schemes. The Electricity Commissioners have held hearings in respect of schemes for two of these districts, and the results can only be described as most unpromising.

The schemes practically depend upon all the authorities in the districts, municipal and company, mutually agreeing; then they have to gain the confidence of the public sufficiently to borrow anything from 4 to 20 million pounds.

"We cannot but think that the Electricity Commissioners must themselves know by this time that the schemes as a whole are failures. In such case the question is whether it is justifiable to hang up the electricity supply of the country for the next year or so simply to have documentary proof through the various hearings that these schemes are unworkable. In the critical state of the industry of the country the time lost will turn out to be a national disaster.

"Were the Electricity Commissioners to decide in their own mind that these schemes are impracticable there would be nothing to prevent the present undertakings themselves developing to meet the necessities of the case. In a number of cases company undertakings are only too willing to go forward. The Yorkshire Electric Power Co. is a case in point. This company is in a position to develop the whole of the supply in the West Riding of Yorkshire, but a prospective electricity authority stands in the way.

"Again, in London the Electricity Commissioners have in their hands an offer of the County of London Electric Supply Co. to erect a large power station at Barking, but this is held over until the problematical Joint Electricity Authority for London has been disposed of. The recent legislation on electricity supply, instead of helping electricity supply as was anticipated, has proved to be the most formidable hindrance."

Refractories for Electric Furnaces.—In an article on this subject in *Chemical and Metallurgical Engineering*, December 22nd, 1920, Mr. R. M. Howe emphasises certain factors concerning the service secured from refractory bricks. They should be protected from rain while being stored, in order to prevent the weakening of their structure. They should be laid up with a material similar to the bricks themselves, or one which will not corrode or flux them, using as small a joint as possible. The furnace should be constructed so that heat will be conducted away from the hotter portions. The ratio of heating to cooling area should be made as low as possible. Refractory bricks or shapes should be heated from one side only in order to keep the heating surface low, and in order to avoid the effect of pressure at high temperatures. Insulation lowers the margin of safety, and should, therefore, be avoided, even to the extent of allowing dust to accumulate on the roof. When the furnace is being heated this should be done gradually, especially where magnesite and silica brick are involved. When the furnace is being cooled it should be remembered that cold blasts produce or accelerate spalling.

The London Engineers' Club.—On Thursday, last week, the first meeting of the Provisional Committee was held at 39, St. James's Street. Mr. Edmund L. Hill was asked to take the chair, and, after reading letters of apology and support from several members of the Committee, including Lord Montagu of Beaulieu, Sir Robt. Hadfield, Mr. C. H. Wordingham and Mr. Ll. B. Atkinson, made an opening statement on the subject of the meeting. He said they met to carry out the mandate given by some 850 engineers to endeavour to establish a club in London for the engineering and allied professions. Some preliminary work had already been done, and it was suggested that the annual subscription should be, for London members, 10 guineas; for country members, 5 guineas; and for oversea members, 2 guineas. The club ought to have every modern convenience, including 80 to 100 bedrooms, lunching and dining accommodation, &c.; they might be able to secure a temporary home in which to make a start whilst looking round for a permanent home. The meeting would be asked to appoint a temporary Executive Committee, representing many branches of engineering, to investigate the possibilities, frame rules, &c., and to report to a general meeting of supporters. In the mass of letters that he had received he had been struck with the smallness of the opposition; the prevailing note was the need of an Engineers' Club, and wonder that it had not come about sooner.

On the motion of Mr. Harry Allcock, it was unanimously resolved that it was desirable "to establish a club in London to be called 'The Engineers' Club.'" The Chairman proposed, Mr. G. Layton seconded, and it was unanimously resolved, that an Executive Committee should be appointed, consisting of Messrs. Howard Foulds, A. H. Allen, R. W. Hughman, G. Layton, W. Prescott, P. C. Pope, H. T. Wilkinson, A. R. Fenn, C. T. Colpitts, H. C. B. Sairsbury, H. W. Cozens, T. C. Pulman, D. Wilson, J. S. Huddleston, H. Scholey and W. Hewison. Mr. A. L. Churchill proposed, Mr. W. W. Hughes seconded, and it was unanimously agreed, that the members of the Provisional Committee should be asked to subscribe £5 each to cover preliminary expenses. The meeting throughout was entirely harmonious and wholly bent on carrying out the proposal to form the Club as soon as possible.

Installation Symbols.—The *Electrical News*, of Toronto, recently published a list of symbols representing various features of electrical installations for the use of architects and electrical contractors. The list is a very comprehensive one, covering practically everything electrical likely to be installed in a house from wall "outlets" to motors. The adoption of such a method in indicating details of this nature on drawings should save a great deal of time and complication.

Appointments Vacant.—Gas manager and electrical engineer (total remuneration, £573) for the Malvern Urban District Council; electrical engineer (£700 + 50 per cent.) for the Government of Kenya Colony; sub-station attendant (£5 13s.), for the Stoke Newington Borough Council Electricity Department; permanent-way foreman, for the Borough of Keighley Tramways Department; telegraph foremen (£440), for the Government of Nigeria. See our advertisement pages to-day.

INSTITUTION NOTES.

Institution of Electrical Engineers.—The annual smoking concert in connection with the Informal Meetings Section of the Institution will be held at Anderton's Hotel, on Monday, Feb. 28th, at 7.30 p.m. Tickets (2s. 6d. each) may be obtained from the Secretary of the Institution, or from any member of the Informal Meetings Section Committee.

At the ordinary meeting of the Institution, on the 10th inst., the President announced that Mr. S. L. Pearce had been compelled to vacate his office of vice-president of the Institution, owing to ill-health, and the Council had elected Mr. A. A. Campbell Swinton, F.R.S., to fill the vacancy.

North-Eastern Centre.—The members of the North-Eastern Centre, in arranging their annual social function, departed from the usual course of having a dinner, and substituted for it a conversazione, which they held in Armstrong College, Newcastle-on-Tyne, on February 11th. The Centre is numerically so strong (possessing as it does 400 members), that it was felt that no undue risks were being taken in arranging such an entertainment, and this judgment was borne out by no fewer than 250 acceptances of invitations being received. The President of the Institution, Mr. Ll. B. Atkinson, and Mrs. Atkinson, who had travelled from London in order to be present, and were supported by Mr. J. R. Beard, chairman of the Centre, and Mrs. Beard, received the guests in the fine King's Hall of the College.

After the reception, the President, in the course of a few remarks, dealt in a humorous manner with the use of electricity in the home, and he did so, he remarked, because of the presence there of so many ladies. They had had a discussion on the matter in London the previous evening, and for the most part it was in connection with the properties, habits, and whims of electric ovens. The ladies would agree that it was an impudent piece of bravado on the part of 200 men to discuss such a subject. What could they know about ovens? They even discussed the evenness of temperature in an an oven. He did not know much about ovens, or cooking, but he did know that everything they put into an oven required either bottom heat or top heat; consequently, these men went well adrift in trying to make an oven of even temperature. Then, again, they talked about taking the temperature in an oven by a thermometer, when it was well known that oven temperatures could not be measured by thermometers, but were either swift, slow, or fierce. But, seriously, he wanted to make an appeal on the subject of domestic appliances. It was necessary that they should be investigated, and the ladies should carry out experiments in their own homes. Women who were unwilling to receive mechanical appliances into their homes were dooming themselves to domestic slavery. It was said that the hand that rocked the cradle ruled the world; it would rule it quite as well if the cradle were rocked mechanically.

For the entertainment of the guests, several features had been arranged. A lantern exhibition of photography in natural colours was given in the Physics Theatre by Mr. F. G. C. Baldwin, and in the Armstrong Laboratory Mr. J. H. Holmes gave some striking illustrations of the effects of high-frequency currents produced by the Tesla coil. In the Electrical Engineering Laboratory there were continuous demonstrations of electrical and other scientific experiments arranged by Prof. W. M. Thornton, D.Sc., and an exhibition of early electrical appliances had been arranged by Mr. J. H. Holmes, in the Herschell Laboratory. The application of electricity to domestic purposes was demonstrated by a varied collection of apparatus shown by Mr. W. F. T. Pinkney. After a round of inspection of these attractions, the guests made their way to the refreshment room, and the evening concluded with a dance in the King's Hall, where Smith's Royal Band during the whole evening rendered a pleasing programme of music.

North-Western Centre.—The President of the Institution, Mr. Ll. B. Atkinson, was present at the meeting of the North-Western Centre, at Manchester, on February 8th, and explained fully the position of the Institution. The proceedings were of a private and somewhat informal nature; in the course of the discussion, several suggestions were made by members with a view to improving the financial position of the Institution, and the President promised that they should be laid before the Council.

A Joint Discussion.—On February 10th and 11th a joint meeting was held by the Institutions of Civil, Electrical, and Mechanical Engineers, at Birmingham, to discuss the Severn Barrage Scheme and its bearing upon the interests of Birmingham. Mr. J. D. Watson, M.Inst.C.E., presided. Mr. R. A. Chattock opened the discussion, advocating the adoption of the Thury system, at a cost of £11,000,000. Other speakers were Prof. F. C. Lee, Messrs. H. P. Raikes, F. H. Clough, G. L. Addenbrooke, N. Rosher, Prof. Burstall, Mr. C. M. Shaw, Mr. F. W. Young, and Profs. W. Cramp and G. Kapp.

Informal Meetings.—At the informal meeting of the Institution on February 14th, a discussion on "Some Notes on the Design of a large Power Station" was opened by Mr. J. R. Cowie (Member of Council). Mr. Cowie had Dalmarnock (Glasgow) station in continual reference for his subject, and he was provided with copious plans and photographs kindly lent by Mr. R. B. Mitchell, chief engineer of this station. He proceeded to describe in detail the super-station. First determining the site by study of a map of the district, then the position of load and accessibility to rail and water. Next the erection from the concrete raft of the footings to the superstructure. He allotted the site its due proportions for stores, boilers, machines, &c., and described in detail and with reasons, the lay-out, system and voltages he would adopt. He asked members to give experiences of economisers with steel tubes, and he also thought further information was required regarding the enormous accretions of ash with post-war fuel. In the discussion, Dr. R. D. Gifford offered the idea of cooling by liquid air, and on the question of the drive of the station auxiliaries, advocated a d.c. house set.

Mr. S. Utting referred to the extension of furnace air heating methods, and Dr. Kapp thought it was making a virtue of necessity as the hot air had to be evacuated. Mr. W. N. C. Clinch spoke of steel economisers, and Mr. E. F. Hetherington knew of a case where galvanising the tubes did not prevent pitting. Mr. A. F. Harmer elicited Mr. Cowie's preference for keeping all metering on the low-pressure side.

Mr. W. J. Oswald, Mr. H. B. Jenkins, Mr. L. M. Jockel, Mr. W. Dargavel, Mr. A. E. Gott, Major K. Edgcumbe, Major R. Grierson and Mr. A. B. Eason also spoke.

Institution of Engineers (India).—The inaugural meeting of the Institution of Engineers (India) has been fixed for February 23rd, in Calcutta. Elections to membership on a very large scale have been made, and it is said that over 500 have already received their notices of election. The president is the Hon. Sir Rajendra Nath Mookerjee, K.C.I.E. The secretary is Mr. Hugh W. Brady, M.I.Mech.E., The Institution, Clive Buildings (Post Box 669), Calcutta.—*Indian Engineering.*

Faraday Society.—The general discussion on "The Failure of Metals under Internal or Prolonged Stress," which is being organised jointly by the Faraday Society, the Institution of Mechanical Engineers, the Institute of Metals, and the Iron and Steel Institute, will take place on April 6th. There will be both afternoon and evening sessions. The North-East Coast Institution of Engineers and Shipbuilders, the Institution of Engineers and Shipbuilders in Scotland, and the West of Scotland Iron and Steel Institute are also participating in the discussion. A preliminary programme has been issued, which states that the discussion will be opened by Dr. W. Rosenhain, F.R.S., who will give a general survey of the subject.

Chelmsford Engineering Society.—On February 10th a lecture on "Electric Welding" was given by Mr. J. H. Johnson, M.I.E.E., illustrated by lantern slides and numerous sample welds, Mr. T. Clarkson, M.I.M.E., presiding. The author gave a few historical details of electric arc and resistance welding, and afterwards described the different systems at present in commercial use for both alternating and direct current. Various photomicrographs and radiographs were shown dealing with the internal examination of metals and welded joints. A discussion followed, and an inspection of different examples of electrically-welded joints.

Belfast Association of Engineers.—At the meeting of the Association, on February 17th, a paper, entitled "Costing in a Small Engineering Works," was read by Mr. James A. Hind, A.M.I.Mech.E. The paper was illustrated by means of lantern slides.

Paisley Association of Electrical Engineers.—On February 2nd Mr. David M'Kay read a paper on "Wireless Telegraphy and Telephony." The speaker gave a detailed history of the subject, and described a large number of instruments. A short discussion followed the reading of the paper.

Institute of Metals.—The annual general meeting of the Institute of Metals will be held at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1, on March 9th and 10th, 1921. The meeting will commence at 10.30 a.m. each day. On March 9th the annual dinner of the Institute will be held, and on March 10th there will be a visit to the National Physical Laboratory. For permission to make this visit the Council is indebted to the director, Sir Joseph Petavel, K.B.E., D.Sc. A special Council meeting will be held in London, on February 23rd, for the express purpose of considering applications for membership. All applications that are found to be in order will be included in a ballot list to be issued to members on February 24th.

S.A. Institute of Electrical Engineers.—The *S.A. Mining and Engineering Journal* states that Mr. L. B. Woodworth is the new President of the S.A. Institute in succession to Mr. A. E. du Pasquier, who is now director of the Metropolitan-Vickers Export Co.

Royal Aeronautical Society.—Meteorology and Aviation.—In discussing the subject of meteorology in the service of aviation, before the above Society, on February 3rd, Major G. Dobson considered various methods of observing weather conditions with a view to gathering such information as would make it possible to produce an accurate weather forecast, and recommended the use of unmanned kite balloons carrying recording instruments. He explained that observation stations could be located along the flying routes, to telegraph (probably by means of wireless) data to a central station. There would be great advantage in employing wireless telegraphy for the transmission of the information, for not only would time be thereby saved, but also any large aerodromes could have their own wireless apparatus and receive not only the information transmitted by the central station, but also that sent by such of the observation stations as were within its range could be intercepted direct, and the delay of circulation through the central station avoided. The lecturer also outlined various methods by which fog might be dissipated over an area sufficiently large to enable an aeroplane to land in safety—namely, by artificially warming or drying the air, and by the electrical discharge method. With regard to the latter, he pointed out that if a pointed rod be introduced into a jar containing artificial fog or smoke, and be charged electrically till a brush discharge takes place from the point, the fog is quickly cleared in a remarkable manner. Methods of this type have frequently been suggested, but it seems certain that all the imaginable effects of an electric discharge (which easily account for the clearing in a jar) would be enormously too small to cause any appreciable clearing on a large scale. Major Dobson has not been able to find any positive results where experiments have been made in the open with this method.

Nottingham Society of Engineers.—On February 21st, Mr. W. Haddock is to give a lecture on "Grinding Machines and Wheels." The Society and other scientific and technical societies of the district have a joint library from which members may borrow volumes. The general public is allowed access to the library for reference purposes.

Society of Engineers (Inc.).—A paper on the "Physical Properties of Clay" which was read recently by Mr. A. S. E. Ackermann, dealt with the results of 107 experiments, and is a continuation of the author's previous paper on "Experiments with Clay in its Relation to Piles" (which was read before the Society in March, 1919, and which was awarded the president's gold medal), wherein the results of the first 102 experiments are recorded. Some of the experiments now recorded are similar to those dealt with in the first paper, and they extend the range of the conditions which held during the earlier experiments; others are new. As a result of the last year's work, the following modifications of the conclusions given in the first paper become necessary: The effect of temperature on the supporting capacity appears to be limited to stresses below the pressure of fluidity, and the sides of a hole appear to crush in before the statical head is equal to the pressure of fluidity. All other conclusions are confirmed, and further ones, which appear to be justified as a result of the new work, are that the tensile strength of clay increases as its water content decreases, and the contraction of clay on drying increases as the original water content increases.

Manchester Wireless Society.—At the meeting held on Feb. 9th, the chairman, Mr. M. Kernan, announced that arrangements were being made with a view to establishing the headquarters of the Society at the Albion Hotel, Piccadilly, and that an aerial would be erected on the roof, and facilities given by the management to allow of reception of signals by members of the Society at stated times. Mr. J. C. A. Reid then read a paper on "Searchlights, and their Work during the War." Mr. Reid gave a very clear account of the work carried out by this section of the Army and Navy, and the many difficulties that were experienced, especially during the early stages of the war.

Birmingham and District Electric Club.—A meeting was held on February 12th, at which a paper was read by Mr. C. G. A. Macdonald, entitled "Reminiscences of the Test Bed." The paper was much more elaborate than was implied by its title. It gave an interesting and detailed account of the technique, methods and instruments used in testing motors, single phase transformers and rotary converters. The paper was illustrated by mathematical formulæ and diagrams, and gave rise to a lively discussion.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Mr. Arthur W. Fithian, M.I.E.E., who for nearly 20 years has acted as engineer and branch manager for the North of England of the Tudor Accumulator Co., Ltd., has now joined Messrs. E. G. Lind & Co., 48A, Buckingham Palace Road, S.W., who have been appointed sole agents for Great Britain and Colonies for the "A.F.A." accumulators.

The directors of the Notting Hill Electric Lighting Co., Ltd., have elected Mr. R. G. Rawkins (who has been secretary of the company for 28 years) to a seat on the Board, in the place of the late Sir William Crookes, O.M., F.R.S.

Mr. W. J. McDonald, traffic superintendent of the Yorkshire (W.R.) Electric Tramways, has resigned his position to join the firm of Messrs. Tate, who handle the distribution of the well-known Ford motor vehicles in the district. The staff and employés at the Wakefield tramway depôt last week presented him with a barometer.

Mr. A. G. F. Heather, A.M.Inst.C.E., is shortly leaving the Metropolitan-Vickers Electrical Export Co., to take up a position as electrical engineer under the Federated Malay States Government.

The L.C.C. Highways Committee recommends that Capt. G. D. Meynell, A.M.Inst.C.E., at present engineer in the London office of the Victoria Falls and Transvaal Power Co., Ltd., be appointed assistant electrical engineer in the tramways department at £600 a year, rising to £800 (based on pre-war conditions), and that as from January 1st, 1921, Mr. H. Underwood, boiler house charge engineer, at Greenwich power station, be promoted to be boiler house superintendent at a commencing salary of £300 a year, rising to £400 per annum (based on pre-war conditions).

According to the *Daily News*, Sir James Currie, who has been Controller of the Industrial Training Department of the Ministry of Labour since 1918, and has given his services voluntarily, is about to retire.

Middlesbrough Gas and Electricity Committee has recommended that the salary of Mr. Scotson, the electrical engineer, be increased by £100 per annum, as from April 1st.

Wrexham Corporation electricity works staff has presented a leather suit case to Mr. Arthur Holt, mains foreman, who is leaving, after 12 years' service, to take up an appointment under the Malvern Urban District Council.

Mr. Arthur Hutchings has severed his connection with the Acme Electric Traction Co., Ltd., Seven Sisters Road, N., and has opened an office at 15, Penton Place, King's Cross, W.C. 1, as consulting electrical engineer, manufacturers' agent, &c.

Obituary.—Mr. W. King Wood.—We regret to hear of the death which occurred suddenly on January 27th, at Teheran, Persia, of Mr. W. King Wood, C.I.E., C.B.E., Director, Persian Section, Indo-European Telegraph Department, at the age of 53 years.

Mr. G. R. Peers.—We regret to record the death, which occurred suddenly on February 10th, of Mr. George R. Peers, A.M.I.E.E., at the age of 54 years.

The many friends of Mr. V. Delebecque, of the Walsall Electrical Co., Ltd., will join with us in expressing sincere sympathy on the death of Mrs. Delebecque, as the result of an accident.

Mr. S. J. Bessant.—The death has taken place, at the age of 22 years, of Mr. Stanley James Bessant, B.Sc., who was an electrical engineer with the British Thomson-Houston Co., Ltd., at Rugby. During the war he held a commission in the Hampshire Regiment, and served in Palestine. He was mentioned in despatches.

Mr. G. Nicholson.—The death has taken place suddenly of Mr. George Nicholson, formerly of Messrs. Nicholson & Waddeley, electrical engineers, North Street, and Great Market, Newcastle-on-Tyne. He was a native of Berwick, and for many years acted as electrician at Alnwick Castle, the seat of the Duke of Northumberland. He was an authority on engineering subjects, and during the war was engaged as an Army electrician at Newcastle-on-Tyne.

NEW COMPANIES REGISTERED.

Lighting, Heating and Power Installations Co., Ltd. (172,969).—Private company. Registered February 4th. Capital, £5,000 in £1 shares. To take over the lighting, heating and power installation business carried on by W. Smith at 16, Atkinson Street, Deansgate, Manchester, and elsewhere, as the Lighting, Heating and Power Installations Co. The first directors are: J. Lytheer, 13, Councillor Lane, Cheadle Hulme, Cheshire; L. A. T. Jesson, Endsley, Swinton, Lancs.; J. H. Langford, Stafford House, 6, Mauldeth Road, Heaton Mersey, Cheshire; W. Smith, 22, Bankhall Road, Heaton Mersey, Cheshire. Qualification, £100. Remuneration as fixed by the company. Secretary: J. Lytheer. Registered office: 16, Atkinson Street, Deansgate, Manchester.

Fyfe Wilson & Co., Ltd. (172,959).—Private company. Registered February 3rd. Capital, £10,000 in £1 shares (8,000 8 per cent. cumulative preference). To take over the business carried on at 31, Budge Row, E.C., and Harlow, Essex, as "Fyfe Wilson & Co.," and to carry on the business of mechanical and electrical engineers, manufacturers of and dealers in electrical apparatus and machinery, &c. The first directors are: H. F. K. Dearlove (permanent managing director), Hill House, Burnt Mill, Essex; A. Hall, Barkway House, near Royston; H. A. May, St. Olaves, Bury Road, Harlow. Registered office: 31, Budge Row, Cannon Street, E.C.

Alklum Electrics, Ltd. (172,950).—Private company. Registered February 3rd. Capital, £1,000 in £1 shares. To carry on the business of general electrical engineers, manufacturers of all kinds of electric apparatus, machines, instruments and accumulators, &c. The first directors are: R. Maude, 20, Hyde Park, Halifax (director, Worsnop & Co., Ltd.); C. H. Worsnop (managing director), Rockville, Halifax (director, Worsnop & Co., Ltd.); H. E. Hodgson, 34, Ashgrove, Bradford; A. Worsnop, 25, Union Street, Halifax; A. Parker, 7, Hyde Park Gardens, Halifax. Registered office: Waterside Works, Waterside, Halifax, Yorks.

Nickeloid Electrotype (an Eyre & Spottiswoode Subsidiary).—The Nickeloid Electrotype Co., Ltd., has been registered as a "private" company, with a nominal capital of £40,000 in £1 shares. The objects are: to adopt an agreement with Eyre & Spottiswoode, Ltd., and to develop the business of electro-deposition, electro-typing, stereotyping and engraving formerly carried on by the said company. The first directors are: G. E. Briscoe Eyre, 18, Redcliffe Square, S.W.; Nigel de Mundeville Bond, Springfield House, Hatfield Peverel; G. O. Smith, 24, St. John's Wood Park, N.W.; A. T. Atkinson, The Old Bells, Bramley, Hants. So long as Eyre & Spottiswoode, Ltd., or their nominees hold 20,000 of the shares allotted to them pursuant to purchase agreement, they may appoint the permanent directors. Secretary: J. S. Crosthwaite. Registered office: 6, Middle New Street, Fetter Lane, E.C.

British Brazing Co., Ltd. (172,903).—Private company. Registered February 1st. Capital, £10,000 in £1 shares. To carry on the business of brazers and welders of metals, engineers, pattern makers, boilermakers, ship, boat and aeroplane builders, &c., and to adopt an agreement with the Marine and Mechanical Electric Welding Co., Ltd. The first directors are: W. Pollock, M.I.Mech.E., 3, Lloyd's Avenue, E.C.3 (chairman of James Pollock, Sons & Co., Ltd., and other companies); T. Ballantine, 34, Queen's Gate, Dowanhill, Glasgow (director, Marine and Mechanical Electric Welding Co., Ltd.); J. McAuslan, Gilchrist, Aytoun, Sydenham Road, Dowanhill, Glasgow (director, Marine and Mechanical Electric Welding Co., Ltd.); J. M. Scott, 139, Hamlet Gardens, Ravenscourt Park, W.C. (director, James Pollock, Sons & Co., Ltd.). Qualification, £250. Registered office, 3, Lloyd's Avenue, E.C.3.

J. H. McBean, Ltd. (173,034).—Private company. Registered February 8th. Capital, £5,000 in £1 shares. To take over the business of an electrical engineer, &c., carried on by J. H. McBean at Clarence Mills, Bradford Road, Batley. The first directors are: J. H. McBean (chairman and permanent managing director), 34, Whitaker Street, Batley; A. W. Blackburn, Waynville, Reservoir Street, Dewsbury. Registered office: Clarence Mills, Bradford Road, Batley.

Whitworth Electric Lamp Co., Ltd. (173,062).—Private company. Registered February 9th. Capital, £5,000 in £1 shares. To carry on the business of an electrical engineer and factor carried on by H. Harrison at 195, North End Road, West Kensington, W.14. The first directors are: H. Harrison, 78, Woodstock Road, Bedford Park, W.4; W. C. Hands, 33, School Road, Moseley, Birmingham (both permanent subject to holding 2,000 shares each). Registered office: 195, North End Road, West Kensington, W.14.

Norwest Electrical Manufacturing Co., Ltd. (11,604).—Private company. Registered in Edinburgh January 29th. Capital, £5,000 in £1 shares. Electrical engineers, electrical machine makers, machinists, metal workers, brass and iron founders, electricians, &c., in the works to be erected by the company at Motherwell, Lanark. The subscribers (each with 100 shares) are: A. N. Penman, 85, Kirk Road, Wishaw, electrical engineer; D. Smith, 5, Cecilia Terrace, Glasgow Road, Wishaw, engineer. The first directors are: A. N. Penman and D. Smith. Solicitors: Logan, Sloan and Rae, Wishaw.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Banbury and District Electric Supply Co., Ltd.—Satisfaction in full on December 31st, 1920, of debenture dated March 26th, 1913, securing £160.

Northampton Electric Light and Power Co., Ltd.—Particulars of £60,000 debenture stock, authorised November 22nd, 1920, and covered by trust deed dated January 5th, 1921, present issue £18,425, charged on the company's undertaking and property, present and future, including uncalled capital, subject to prior deed securing £50,000 first debenture stock. Trustees: C. C. Fisher, C.B.E., Chipston House, Market Harborough; J. Pendered, "Redwell," Wellingborough; and P. H. Page, 33, Billing Road, Northampton. Satisfaction in full on January 1st, 1921, of debentures dated November 12th and December 3rd, 1915, October 31st, 1916, and January 17th, 1917, securing £18,600.

Hexham and District Electric Supply Co., Ltd.—Satisfaction in full on January 24th, 1921, of debentures dated January 20th, 1908, and April 28th, 1909, securing £3,350 and prior lien debentures dated May 24th, 1917, securing £4,300.

Sheerness and District Electric Power and Traction Co., Ltd.—Satisfaction in full on January 1st, 1921, of debentures dated February 12th, 1915, securing £300.

Park Royal Engineering Works, Ltd.—Particulars of £9,000 debentures authorised December 23rd, 1920, whole amount issued; charged on the company's undertaking and property, present and future, including uncalled capital, subject to prior charges.

West India and Panama Telegraph Co., Ltd.—Particulars of £100,000 first mortgage debentures authorised by resolutions of May 13th, 1891, and December 15th, 1920; present issue £20,000; charged on company's undertaking and property, present and future.

Vulcan Arc Welding and Transport Co., Ltd.—Mortgage dated January 11th, 1921, to secure £5,000 charged on certain land and premises in Wigan. Holder: J. A. Fairhurst, Arlington Manor, Newbury, Berks.

Stearn Electric Lamps Co., Ltd.—Debenture dated January 17th, 1921, to secure £10,000; charged on real estate, plant machinery, undertaking and assets. Holder: Sir Maxwell Hicks, Kt., 20, Copthall Avenue, E.C.

Hackbridge Cable Co., Ltd.—Particulars of £40,000 debentures authorised January 11th, 1921; whole amount issued; charged on company's undertaking and property, present and future, including uncalled capital.

Ilford Dry Battery Co., Ltd.—Satisfaction in full on June 19th, 1919, of debentures dated August 23rd, 1916, securing £1,250.

Ingleton Electric Lighting and Power Co., Ltd.—Issue on February 1st, 1921, of £500 debentures, part of a series already registered.

English Electric Co., Ltd.—Particulars of £1,250,000 debentures (being 12,500 Notes of £100 each carrying interest of 8 per cent. per annum), authorised by resolution of November 22nd, 1920, and covered by trust deed dated January 1st, 1921, whole amount issued; charged on the company's undertaking and property, present and future, including uncalled capital. Trustees: Anglo-American Debenture Corporation, Ltd.

Brownlee & Green, Ltd.—Deed of assignment dated January 14th, 1921, to secure £2,460 19s. 3d. charged on certain payments due to the company. Holder: Clay Cross Co., Ltd.

F. L. Mitchell & Co., Ltd.—Particulars of £650 debentures authorised January 26th, 1921; whole amount issued; charged on the company's undertaking and property, present and future, including uncalled capital.

Automatic Telephone Manufacturing Co., Ltd.—Particulars of £350,000 debentures authorised December 9th, 1920, and covered by trust deed dated January 17th, 1921; whole amount issued; charged on company's undertaking and property, present and future, including uncalled capital, freehold hereditaments, buildings, plant, machinery, &c. Trustees: London County, Westminster and Parr's Bank, Ltd.

East Anglian Electricity, Ltd.—Mortgage dated February 1st, 1921, to secure £1,000, charged on certain freehold land and buildings at The Quay, Sudbury, Suffolk. Holder: F. R. Francis, Sudbury, Suffolk.

CITY NOTES.

Westminster Electric Supply Corporation, Ltd.

The total connections increased during 1920 from 52,457 kW to 56,652 kW. After referring to the new Bill which is likely to be introduced, the directors say:—

The Electricity Commissioners, acting under the Electricity (Supply) Act, 1919, have provisionally determined a London District and have asked for schemes to establish an Electricity Authority for the district.

A majority of the London companies, including this company, in association with the L.C.C. and the Conference of Local Authorities, have in preparation a technical scheme which they propose to submit for consideration by the Commissioners.

The extremely important administrative and financial conditions which should govern the creation and powers of a Joint Electricity Authority are at present having the careful consideration of the associated companies in view, especially, of the necessity for safeguarding the interests of their shareholders.

It is hoped that the scheme ultimately put forward will be such as to secure the best use of existing resources and experience, with the object of producing and selling electricity as widely and cheaply as possible.

After allowing for depreciation, sinking fund, and other charges, and paying the preference dividend, the total distribution on the ordinary for the year, less income tax, is 10 per cent., leaving £12,698 to carry forward. Units generated, 28,890,889; units sold, 25,659,191.

St. James' and Pall Mall Electric Light Co., Ltd.

The connections increased from 18,902 kW to 19,904 kW during 1920, and 13,510,297 units were supplied to consumers. Net profit £28,310, plus £8,577 brought forward. Preference dividend (7 per cent.), £7,000; ordinary dividend total for the year 12 per cent., £24,000; carried forward £5,887. The Electricity (Supply) (No. 2) Bill, which is likely to be proceeded with in the forthcoming session, appears to need amendment in certain particulars in the interests of the existing undertakers, and the directors are taking steps to get amendments moved. The report contains the same references to this matter as are given in the Westminster report above.

The death is recorded of Mr. Marlborough R. Pryor, a director, and Messrs. M. Gluckstein and R. H. Benson have been elected to the board.

Units generated by steam plant, 482,051; purchased, 17,128,333.

London Electric Supply Corporation, Ltd.

Profit for 1920, £99,487, against £95,240 in 1919. Add brought forward £11,500. Interest on temporary loan, &c., £1,379; debenture interest and sinking fund, £40,074; preference dividend (6 per cent.), £26,952; dividend of 2½ per cent. on the ordinary shares, £8,325; reserve, £15,000; contingencies, £5,000; carry forward, £14,257. Sinking fund for redemption of debenture stock in 1931 is now £150,226, in addition to £55,918 shown in the capital statement under the agreement with the St. James' and Westminster companies. Units sold 47,366,351, against 42,907,637 in 1919. Total costs per unit sold 1.38d., against 1.17d. Average receipt per unit sold (lighting and power) 1.81d., against 1.60d. Mr. G. W. Partridge has been appointed managing director in place of the late Mr. R. Stewart Bain. In regard to electricity legislation, the directors say it is hoped that the scheme ultimately adopted will be such as to secure the best use of existing resources and experience, with the object of producing and selling electricity as widely and as cheaply as possible. Meeting: February 21st.

South Metropolitan Electric Light & Power Co., Ltd.

Credit balance for 1920, £82,821 plus £12,323 brought forward; also 10 per cent. on holding in West Kent Electric Co., Ltd., £1,002; total £96,146. Debenture and other interest £15,861; 7 per cent. dividend on cumulative first preference shares and 6 per cent. on the second; £23,000 to depreciation; £10,000 to reserve; 8 per cent. dividend on the ordinary shares, less income tax, £13,200; to be carried forward £18,260. Despite the unfavourable conditions which prevailed during the year, the business of the company shows a satisfactory improvement. Meeting, Winchester House, February 23rd.

Lanarkshire Tramways Co., Ltd.

Revenue during 1920 £229,546; expenses £197,967; leaving £31,579. Contributions to local authorities absorb £2,011; income tax £1,809; interest on debentures £643; interest accounts £4,053; depreciation reserve £9,000. Balance £14,062, plus £5,280 brought forward; total £19,342. After paying 5 per cent. for the year on the shares (£18,211), £1,131 is carried forward. The revenue shows an increase of £29,678 and the expenses an increase of £49,907, and there is also an increase on deferred repairs of £7,763; the increase in expenses was caused by the additional charges for electrical energy, wages, and extensive repairs. A provisional order was granted in December last authorising the company to abolish halfpenny fare stages, and to run motor omnibuses within the county borough of Lanark. As the Lanark County Council did not accept the terms upon which the company was prepared to dispose of the undertaking, the company has acquired the lines constructed by the County Council at cost price (£60,981). Passengers carried 1920, 35,584,191, as against 31,521,049 for 1919. Meeting, Cannon Street, February 28th.

Metropolitan Railway Co.

At the ordinary general meeting, held on February 10th, Lord Aberconway (chairman), in presenting the directors' report, said that only the last four months of the period covered by the accounts showed any benefit from increased fares, while the increased expenses prevailed for the whole of the 12 months. With a current consumption increase of only 1 per cent., a mileage increase of 11 per cent., or 2½ million miles, was obtained. Lord Aberconway expressed the opinion that the cost of fuel and most other items of expenditure had reached its highest point, and that substantial reductions could be looked for in the present year. The company did not view the prospect of decontrol in August next, or at a later date, with any apprehension. The increased dividend was made possible by the receipts from that part of the undertaking remaining free from Government control. The effect of continued wages increases had been to raise the wages bill to a permanent figure three times the pre-war amount, and shorter hours made the position worse for the company. During the period covered by the accounts twelve new electric coaches had been delivered, as well as seven steam stock trains. The improvement in the design of the electric locomotives to increase their haulage capacity by 50 per cent. and to raise their speed had proceeded satisfactorily. Commenting upon the additions, the speaker said that the new design of car was, in the opinion of their experts, the best suited to this type of traffic, comparing favourably with any in this country for comfort and convenience. Arrangements had been made to increase the capacity of the generating plant at Neasden by the addition of a 12,000-kW turbo-generator, with the necessary steam plant. Referring to the proposed grouping of railways, Lord Aberconway thought that the Metropolitan would be put into a group with the District, the "Tubes," the East London Railways, and what might be called the General Metropolitan group.

Yorkshire Electric Power Co.

In presenting the directors' report and accounts at the annual meeting, held on February 15th, the chairman (Mr. A. G. Lupton) said that although many of their customers were working short time, new consumers had brought the demand for power up to a higher level. The company now had in operation 446 miles of mains conveying electricity to 164 sub-stations supplying in the areas of 84 local authorities in the West Riding. In addition to direct supply to steel works, tramways, shipyards, collieries, factories, &c., the company was giving bulk supplies for distribution to the holders of 40 provisional orders. Working agreements were now in operation with Bradford, Sheffield, Rotherham, Dewsbury, and Batley. Their mains were on the point of being coupled up with those of Sheffield at the southern extremity of their area, and supplies were being given already to Otley on the northern boundary, Todmorden in the west, and Pontefract in the east. This had been accomplished in less than 20 years, and in spite of the scattered nature of the population served, their prices were as low as those in the densely populated cities of the West Riding. It had been in the minds of some of the company that another 20 years would see an unbroken supply, through other undertakings, through Yorkshire to Birmingham and Rugby, and stretching out to Lancashire and Lincolnshire, not only for factories and householders but ultimately to the railways. Unfortunately, at the present time, the company was prevented from going forward with the large station at Ferrybridge. This was urgently needed, and if the proposals for nationalisation had not intervened it would have been in hand. The expenditure of the million pounds involved would have provided work for men and British engineering shops, and would have been of some value in solving the problem of unemployment. The speaker deprecated the action of the Government and local authorities in holding up the development of useful schemes such as the company's, while road and other schemes of little practical value were proceeded with. The provisions of the Electricity (Supply) Act would not deal satisfactorily with the question of electricity supply on a great scale. The distribution of electricity to wide areas could not be carried out by such parochial schemes which did not realise the possibilities of the future.

Underground Electric Railway Companies.

A summary of the results of working of the four railway companies and the London General Omnibus Co. for the year ended December 31st, 1920, is given below.

	1920.	Increase + or Decrease −
	£	£
Traffic Receipts	10,895,881	+ 1,785,411
Government Compensation to Sept. 26th, 1920 (after providing for adjustments)	705,347	+ 138,977
Total	11,601,228	+ 1,924,388
Operating Expenses	10,378,847	+ 2,199,249
Net Receipts	1,222,381	− 274,861
Miscellaneous Receipts (Net)	693,998	+ 130,369
Net Income	1,916,379	− 144,492
Interest, Rentals and other Fixed Charges	825,910	− 2,597
Balance	1,090,469	− 141,895
Reserve for Contingencies and Renewals	420,000	—
Balance	670,469	− 141,895
Dividends on Guaranteed and Preference Stocks, excluding M.D.R. Second Preference Stock	315,977	—
Surplus Paid into or *Deficit* met out of Common Fund	354,492	− 141,895
Amount Received from Common Fund	354,492	− 141,895
Per cent.	100 %	—
Add Balances from last year's Accounts	134,278	− 13,640
Total amount available for Dividends and further Reserves	488,770	− 155,535

Further statistics are also given which show a large increase in the number of car miles run and in the number of passengers carried, although the latter is not so great as the previous year's increase.

Passengers carried—

Ordinary	1,041,750,266	+85,053,376
Workmen	73,832,349	+ 5,329,061
Season	56,119,253	+ 7,926,883
Total ...	1,171,701,868	+98,309,320
Average fare per passenger ...	2.18	+ .19
Number of car miles run ...	148,728,900	+17,751,663

The reports of individual members of the group are given below.

Central London Railway Co.—The total net income amounted to £166,569, a decrease of £20,347. This, with a balance of £11,762 brought forward, made a total of £178,331. From this were deducted interest, rentals, and other fixed charges, £54,071; appropriation to reserve £20,000, and dividend on preference stock £21,600, leaving an available balance of £82,660. After payment of final dividends the sum of £15,160 is carried forward.

Metropolitan District Railway Co.—Total net income £539,840, a decrease of £25,771, this, with the balance brought forward, amounts to £561,938. Interest, rentals, and other fixed charges £327,371, appropriation to reserve £45,000, dividends on guaranteed and first preference stocks £124,930, leaving a balance of £64,637 available for distribution. Of this a dividend at the rate of 3 per cent. per annum on the second preference stock absorbs £44,100, and a balance of £20,537 is carried forward.

London Electric Railway Co.—Total net income £564,561, a decrease of £47,041, this, with a balance of £20,942 brought forward, amounts to £585,503. Of this total interest, rentals, and other fixed charges absorb £286,266, appropriation to reserve £45,000, and dividend on preference stock £126,947, leaving an available balance of £127,290. This is allotted as follows: Dividend on ordinary shares fully paid at the rate of 1½ per cent. per annum £104,940, balance carried forward to next year's account £22,350.

City & South London Railway Co.—Total net income £138,389, a decrease of £6,098; balance brought forward £19,750; total, £158,139. Interest, rentals, and other fixed charges £49,619, appropriation to reserve £25,000, dividends on preference stock £42,500, leaving a disposable surplus of £41,020. Of this balance, £3,700 is absorbed by the payment of an interim dividend of ½ per cent., and £18,500 by a final dividend of 1½ per cent. on the consolidated ordinary stock, leaving £18,820 to be carried forward. The directors of this company regret that owing to financial stringency they have been unable to proceed with the reconstruction and re-equipment of the railway, although the other three companies report the delivery of new rolling stock.

Bruce Peebles & Co., Ltd.

Profit for 1920, including interest on investments and transfer fees, and after deducting income tax, administration expenses, and the amount required for debenture service £74,714, plus £5,462 brought forward. To reserve for E.P.D. and corporation profits tax £35,000; depreciation reserve £8,000; general reserve £10,000; 7½ per cent. per annum on the preference shares, and a further 2½ per cent. making 10 per cent., less tax, £5,107; 10 per cent. on the ordinary, less tax, £16,246; carried forward £5,823. The works were fully employed during the year, and the result is satisfactory; prospects for 1921 are good. It is proposed to issue the balance of the authorised share capital, 36,469 in ordinary shares, and the ordinary shareholders will be invited to subscribe for these at par, less a commission of 10 per cent., or 18s. net. The shareholders will have the right to subscribe for two new ordinary shares for each nine ordinary shares now held. Conditional allotment letters will be issued with the dividend warrants. In June last the directors appointed Mr. S. E. Bastow, formerly one of the joint managers of the company, and subsequently chief engineer to The British Dyestuffs Corporation, Ltd., to be managing director of the company. His appointment will be submitted for confirmation at the annual general meeting. Mr. James Watt has agreed to join the board if appointed.

Meeting: Edinburgh, February 21st.

Dublin United (Electric) Tramways Co., Ltd.

Presiding at the annual meeting, the Rt. Hon. Laurence A. Waldron, P.C., chairman, stated that the total revenue was £43,254 over that of 1919, in which year they had the highest revenue previously attained by their operations. The result in the year just closed was achieved in spite of the unsettled conditions in the working area, which was accountable for recurring interruptions, and had resulted in loss of traffic. From this cause and the extension of the curfew to 10 p.m., in the Metropolitan area, under the military regulation, they had lost at least £200 a day in gross receipts, while owing to the 10 o'clock curfew he estimated a loss of about 2,000,000 passengers since October. There was some fear at the moment that a further extension of curfew would be made. In that case he did not know what would happen, but his opinion was that the effect in regard to themselves would be to paralyse the business of the company, and no doubt other great undertakings would also be most seriously affected. Labour and material this year showed a total of £109,047, being £32,120 in respect of material, £76,927 in respect of wages, and an increase in general charges, bringing the total increased working and general expenses up to £124,487 for the year. The loss in passengers was offset to some extent by the increased fares which they were permitted to institute a few months ago. On the whole, the chairman thought the shareholders were to be congratulated on their position. The stock of cars had been inproved, and added to, and rebuilding had been done at their own works at Inchicore. The condition of permanent way and rolling stock compared favourably with other tramways in the United Kingdom; indeed, they had exceeded the programme of renewals he set before them last year.

A resolution was passed declaring a 6 per cent. dividend for the half-year on preference stock and a final dividend of 7 per cent. on the ordinary stock, which, with the interim dividend, made 5½ per cent. for the year.

French Companies.

At the meeting on December 17th of the *Société Industrielle des Téléphones* the report was approved and a dividend of 35 fr. per share voted.

The results of the year's working of the *Energie Electrique du Nord de la France* showed a net profit of 1,213,778 fr., allowing of a distribution of 30 fr. per share.

The report of the board of the *Compagnie Générale d'Electricité*, read at the meeting on December 20th, indicated the progress of the many undertakings the company has in hand. The net profits had risen to 7,370,815 fr., being 885,463 fr. above those of the foregoing year. The kWh sold by the branches totalled 95,089,000, against 82,764,000 in 1919 and 47,494,000 in 1914. A dividend of 60 fr. per share was declared.

The accounts for the working year of the *Sud Electrique*, submitted for the approval of the meeting of December 22nd, showed a profit balance of 1,888,668 fr., allowing of the payment of a dividend of 6 per cent. The network worked by the company now extends to 1,744 kilometres of high and low-pressure mains. The dividends distributed by the company's two offshoots were: Société Avignonnaise d'Electricité, 0 per cent.; and the Société Nimoise d'Electricité, 10 per cent. The company is also interested in the Electro Culture and the Société Générale Agricole—undertakings concerned with adapting electricity to agriculture.

The meeting on December 23rd of the *Exploitations Electriques* voted the distribution, as from April 1st, 1921, of a dividend of 17.50 fr. per share and 15 to 16 per cent. per part, the profits amounting to 1,007,207 fr. Favourable accounts were given of the working of the many traction, distribution and construction companies with which the company is concerned.

The rise in the Swiss rates of exchange has not permitted the *Société des Applications Industrielles* (which has big interests in Switzerland) to make the distribution of a dividend, notwithstanding that 1,518,502 fr. profit was realised during the year's working. The reserve against the risks of exchange was advanced to 3,500,000 fr.

The accounts submitted to the meeting on December 30th of the *Société Alsacienne et Lorraine d'Electricité* disclosed a deficit of 38,561 fr. The company is an offshoot of the Thomson-Houston company, and recently increased its capital from 1,000,000 fr. to 12,000,000 fr.

At the recent ordinary meeting of the shareholders of the *Compagnie Electrique de La Loire et du Centre* it was reported that the steps taken to obtain an increase in the tariff both from clients and the municipalities to cover the increased cost of working owing to the dearness of coal and prime materials had been temporarily successful, pending the fixing of a definite tariff by the experts. The energy consumed by the company's customers had sensibly declined in the year 1918-19, owing to the stoppage of business caused by the war; but the industrial revival was clearly shown in the year 1919-20 by the progressive increase in the call for electric current, to the extent that at the end of the latter period consumption was 31 per cent. in excess of the former. The total receipts were 19,215,738 fr. against 15,732,863 fr. in the year before. The outgoings, including bond interest, and loss on exchange totalled 19,215,738 fr. The profit balance was consequently 4,516,097 fr. The company has carried out the repairs to the generating groups and transformers which could not be effected during the war. At the end of May a group of 6,000-kW generators at the Montaud à St. Etienne station was the seat of a short circuit which caused a fire in the stator. The insurance covered almost the whole loss. The output of energy was 148,401,377 kWh, against 146,445,471 in 1918-19. Important new works were under way on several sectors of the company—St. Etienne, Roanne, Montluçon. The council proposed to devote 1,207,525 fr. to various sinking funds and to fix the dividend on the numbered shares at 20 fr. gross per share. The distribution was approved.

National Gas Engine Co., Ltd.—Net profit for 1920, after providing for depreciation of buildings, plant, tools, &c., and allowing for management salaries, corporation profits tax, and income tax, £92,062. Final dividend of 5 per cent. on the preference shares; also final dividend of 7½ per cent. per annum on the ordinary shares, less income tax (in addition to interim of 7½ per cent. already paid), on the ordinary, together with a bonus of 9d. per share. Balance forward £57,332.

Electrical Distribution of Yorkshire, Ltd.—The directors' report for the year ended December 31st last shows a net profit of £5,426 as against £4,354 for the previous year. This, with the balance brought forward, makes a total of £6,579 for distribution. £3,883 is allocated to a dividend at the rate of 6 per cent. per annum (free of income tax) on the ordinary shares, £1,000 is put to reserve, and £1,696 is carried forward.

Cambridge Electric Supply Co., Ltd.—The accounts for 1920 show a profit of £9,584, which with £2,382 brought forward totals £11,966. Debenture and other interest absorbs £2,096, depreciation fund £3,000; 5 per cent. dividend is to be paid (£4,758) and £2,111 is carried forward. Owing to the growth of the company's business £10,000 7½ per cent. "C" debentures were offered by the directors to the members in April last; of these £8,000 have been taken up, leaving a further £2,000 still on offer.

Tyneside Tramways & Tramroads Co.—Surplus of receipts over expenses £3,341 for the December, 1920, half-year, plus £1,011 brought forward. After deducting interest on mortgages, loans, &c., 5 per cent. per annum (less tax) is to be paid on the preference shares and 3 per cent. (less tax) on the ordinary (making 4 per cent. for the year); £488 is to be carried forward. Increase in traffic receipts £2,051, as compared with the corresponding half of 1919. For the whole year the increase was £6,580, but the increased costs of operation have exceeded this advance.

W. T. Henley's Telegraph Works Co., Ltd.—Final dividend on the ordinary shares issued prior to January 1st, 1921, of 2s. per share less income tax, making, with the interim dividend of 1s. per share, 3s. per share for the year.

South Metropolitan Electric Light & Power Co., Ltd.—The transfer books are closed until February 28th for the preparation of warrants for dividends payable on and after 28th inst. on the preference and the ordinary shares.

Stock Exchange Notice.—The Committee has ordered the undermentioned to be officially quoted:—

Crompton & Co.—250,000 ordinary shares of £1 each, fully paid (Nos. 79,540 to 329,539).

Clontarf and Hill of Howth Tramway Co.—A dividend at the rate of 3 per cent. per annum, less tax, has been declared.

Parsons Marine Steam Turbine Co., Ltd.—Interim dividend of 7½ per cent., free of tax.

Rushden and District Electric Supply Co., Ltd.—Final dividend of 4 per cent., making 6½ per cent. for the year.

Montreal Light, Heat & Power Co.—Gross revenue for 1920, $12,748,409; expenses and taxes absorbed $6,810,286, depreciation and renewal reserve $1,055,166, leaving net revenue $4,882,956, less fixed charges $1,078,449, leaving net income $3,804,506; dividends paid absorbed $2,683,443, dividend accrued (not declared) $537,295; surplus $583,767, less appropriated for pensions $20,000; transferred to general surplus, subject to tax, $563,767.—*Financial Times.*

New Issue.—The issue of 30,000 eight per cent. cumulative preference shares in the Melbourne Electric Supply Co., Ltd., was over-subscribed, and the lists were closed on Monday.

Northampton Electric Light and Power Co., Ltd.—Final dividend on the ordinary shares at the rate of 5¼ per cent., making 8 per cent. for the year, as against 7 per cent. last year.

Central Electric Supply Co., Ltd.—During 1920 energy was supplied to the Westminster, St. James' & Pall Mall, and Chelsea companies to an amount of 38,246,260 units.

Smithfield Markets Electric Supply Co., Ltd.—Dividend 5 per cent. on the ordinary shares for 1920.

Fife Tramways, Light and Power Co.—Dividend 8 per cent. for 1920.

STOCKS AND SHARES.

Tuesday Evening.

The general conditions of Stock Exchange markets are not unsatisfactory, although it cannot be said that they call for any particular enthusiasm on the part of members of the House. There is not enough business to go round the four thousand odd men who make up the membership of the Stock Exchange. Clients are not anxious to do much one way or the other at the present time. The tide of investment sets strongly towards gilt-edged issues. Banks, insurance companies and other financial institutions are buying heavily. The boom in life assurance contributes to the remarkably big sums that are being utilised in gilt-edged issues. On the other hand, Home Railway stocks, debenture, preference, guaranteed and ordinary are flat, in consequence of the pessimistic utterances of various chairmen at the meetings last week. Talk of a fall in the Bank Rate has retired into the background, and the hopes of an early alteration are no longer urgent.

The reports of the Underground Electric railway companies have their points of theoretical interest, although for all practical purposes the figures published in this column last week deserve greater attention. It is very obvious that the decreased dividends which we set out have come as a result of enormously increased charges. The railway companies unite in a common cry of the impossibility of making profits with wages and materials at their present level. Precisely the same wail comes from America, where it is held that fares and charges have already reached limits beyond which it is practically impossible to go without serious risk of losing traffic. The only other way in which net earnings can be increased is through economies in working, reduction of staffs, lower wages, cheaper coal, &c. The same conditions apply to our railways over here, and the opening of Parliament on Tuesday was never awaited with more anxiety by railway shareholders, who look to the present session to produce legislation that shall give railway stockholders a reasonable hope for profit upon their investments.

Movements in the cable stocks have been mostly upward. Eastern ordinary has risen to 160½. Globe ordinary and preference are harder, and Eastern Extensions remain at 15½. Western Telegraphs at 16. There is scarcely enough difference between the various prices to make it worth while for the holder of Eastern ordinary stock to sell this and re-invest the money in Eastern Extensions or Globes, though the movements in the prices of the quartette will be closely watched with a view to making this kind of straddle if the opportunity offers. Marconis went back to 1⅞ and rallied to 38s. 9d. Radio preference touched 12s., to ease off to 11s. 6d. The common shares keep about 9s.

Chili Telephones are ¼ down at 5½, and the American group holds its prices. Most of the stocks and shares of the dollar issues are better on the week, owing, of course, to the movements in the New York exchange. Brazilian Tractions are 38, showing a point advance, but they have been up to 39. Rio Tramways first mortgage bonds eased off to 87.

The possibility of a railway strike has combined with other fears to produce pronounced flatness amongst Home Railway stocks. Underground Incomes are better at 68½, but Metropolitans, Districts and practically the whole list of the steam stocks are lower, the steam stocks substantially so. There is no confidence felt in the market, and prices are shrinking away under the incessant pressure to sell in a market where buyers become increasingly rare. East London ordinary has dropped to 3. City and South London 4 per cent. debenture is lower at 42½. Numbers of prior-charge stocks show falls of one or two points on the week.

County of London Preference improved to 7⅞, and Charing Cross preference at 2⅝ recovered the 2s. 3d. per share dividend deducted last week. Westminsters sagged to 5½. Apart from these, there are no changes worth mentioning in the list of electricity supply shares. In the new session of Parliament it is expected that the Government will proceed with its ambitious Electricity Bill.

Newcastle-on-Tyne ordinary gave way to 14s. 6d. Yorkshire (West Riding) ordinary weakened to 17s. 6d. In the foreign list, Para 6 per cent. preference at 10s. and the ordinary at 8s. 9d. are both easier.

A reader writes from India to ask for the inclusion in our price-lists of English Electric quotations. It is a pleasure to comply with a request so reasonable. The manufacturing shares are heavy in tone. Edisons have fallen 1s. 3d. to 10s. 9d. British Aluminiums are 1s. down at 17s. 6d. General Electrics at 1 7/32 have recovered the small fraction lost last week. Babcock & Wilcox hold their improvement at 2½. The armament group is lower, Vickers dropping sharply and taking Armstrongs in their train. Iron, coal and steel shares have given way because of the prevailing trade depression. But the public are not buyers of any industrial shares just now.

Rubber has gone up a penny or two without, however, arousing any particular interest. Share values are therefore limp, and business is stagnant. Reorganisation of capital account is regarded as almost inevitable in the case of certain of the financially weaker companies. Indeed, there are evident signs that the inordinate inflation of capital by many trading companies during the war period must bring nemesis in its train, and that the pruning-knife will have to be applied drastically to some accounts in order to bring capital into closer relation with assets that have shrunk with even greater rapidity than they previously expanded.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Feb. 15, 1921.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	8	12	8½	—	£10 4 4
Charing Cross Ordinary	4	7	4	—	8 15 0
do. do. do. 4½ Pref.	4½	4½	92 xd.	—	8 8 8
Chelsea	8	4	8¼	—	8 8 0
City of London	8	10	24/3	—	8 5 4
do. do. 6 per cent. Pref.	6	6	17/6	—	6 17 2
County of London	7	8	7⅞	—	10 18 4
do. do. 6 per cent. Pref.	6	6	7⅞	+ ⅛	7 12 4
Kensington Ordinary	6	7	8¼	—	9 0 6
London Electric	Nil	3½	7	—	10 0 0
do. do. 6 per cent. Pref.	6	6	9⅞	—	10 18 2
Metropolitan	5	6	5¾	—	10 8 8
do. 4½ per cent. Pref.	4½	4½	2⅞	—	8 15 8
St. James' and Pall Mall	10	12	6½	—	9 13 0
South London	5	6	9⅛	—	9 2 10
South Metropolitan Pref.	7	7	13/9	—	10 8 8
Westminster Ordinary	8	10	5¼	— ⅛	9 15 2
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	81½	—	7 7 8
do. Def.	33/6	1¼	16½	—	9 6 6
Chile Telephone	8	8	8½	— ⅛	*5 6 8
Cuba Sub. Ord.	7	7	6½	—	*10 15 4
Eastern Extension		10	12½	—	*8 9 0
Eastern Tel. Ord.	8	10	16½	+1	*6 4 8
Globe Tel. and T. Ord.	8	10	15⅝	+ ⅛	*5 8 0
do. do. Pref.	6	6	9	+ ⅛	6 13 4
Great Northern Tel.	22	22	22	—	10 0 0
Indo-European	18	10	80	—	8 6 8
Marconi	25	25	1⅛	—	—
Oriental Telephone Ord.	10	12	2⅛	—	*5 4 0
United R. Plate Tel.	8	8	6½	—	*8 5 0
West India and Panama	1/8	Nil	⅛	—	Nil
Western Telegraph	8	10	15	—	*8 5 0
Home Rails.					
Central London Ord. Assented	4	4	43½	—	9 4 9
Metropolitan	1	1½	20½	−1	7 6 4
do. District	Nil	Nil	15	−1	Nil
Underground Electric Ordinary	Nil	Nil	1⅞	— ⅛	Nil
do. do. "A"	Nil	Nil	5/6	—	Nil
do. do. Income	5	4	68½	+1	2 18 8
Foreign Trams, &c.					
Anglo-Arg. Trams, First Pref.	Nil	5½	2⅜	— ⅛	10 9 6
do. do. 2nd Pref.	Nil	Nil	⅜	—	Nil
do. do. 5 % Deb.	5	5	59½	—	8 8 0
Brazil Tractions	Nil	Nil	38	+1	Nil
British Columbia Elec. Ry. Pfce.	5	5	56	—	8 18 6
do. do. Preferred	2½	5	58½	—	*8 16 0
do. do. Deferred	Nil	3	51½	—	*12 2 6
do. do. Deb.	4½	4½	65½	+1	7 13 2
Mexico Trams 5 per cent. Bonds	Nil	Nil	40½	—	Nil
do. 6 per cent. Bonds	Nil	Nil	26½	—	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	21½	—	Nil
do. 1st Bonds	Nil	Nil	68½	—	Nil
Manufacturing Companies.					
Babcock & Wilcox	15	15	9½	—	*6 13 8
British Aluminium Ord.	10	10	17/6	— 1/-	11 8 6
British Insulated Ord.	12½	15	1⅜	—	9 5 10
Callenders	25	15	1⅜	—	10 18 2
„ 6½ Pref.	6½	6½	17/6	—	7 8 7
Castner-Kellner	20	17	2⅞	—	7 12 9
Crompton Ord.	10	10	13/9	—	14 11 0
Edison-Swan	10	10	10/9	—1/3	—
do. do. 5 per cent. Deb.	5	5	70	—	7 2 10
Electric Construction	10	10	⅜	—	11 8 6
English Electric	—	8	14/6	—	10 19 2
Do. Pref.	—	6	1⅛	—	8 11 6
Gen. Elec. Pref.	6½	6½	18/6	—	7 2 5
do. Ord.	10	10	1⅞	+ ⅛	*8 4 0
Henley	25	15	1⅞	—	10 5 0
do. 4½ Pref.	4½	4½	8½	—	5 12 6
India-Rubber	10	10	⅜	—	—
Mot.-Vickers Pref.	—	8	11½	—	8 18 4
Siemens Ord.	10	10	1⅞	—	*9 12 8
Telegraph Con.	20	20	21½	—	*5 11 3

* Dividends paid free of Income Tax.

THE BROWN-BOVERI MERCURY ARC RECTIFIER FOR LARGE OUTPUTS.

By R. L. MORRISON, A.M.I.E.E.

Introduction.—It has been said the ideal is impossible of attainment. We can, however, approach very close to it, whether in ethics or machinery matters not, and the operation of the plant described in this article is acknowledged, by those competent to judge, as being of that order.

For many years there has been a widespread demand for some simple form of direct current converting plant that could be compared in simplicity and reliability with the ordinary transformer. At the present time the position is an acute one on account of high attendance charges that must in most cases be provided for with direct current sub-stations using running machinery, though to some extent the position has eased by the introduction of the automatically operated rotary converter. This, however, does not eliminate the running machine, and many of those responsible for the generation and distribution of electrical energy have considered the advisability of eliminating as far as possible direct current from their systems in favour of alternating current, where this could be conveniently done without too great ex-

Fig. 1.—The Mercury Arc.

penditure, though it should not be forgotten that for the average municipal undertaking direct current stands pre-eminent as the most suitable all-round supply.

It is now possible to have stationary direct current sub-station plant, and this fact has given a new lease of life to this form of supply. These conditions are fulfilled by the introduction of the large mercury arc rectifier. The success that has attended, in so comparatively short a time, the efforts of those responsible for its development is very encouraging, and judging by the eminently satisfactory results obtained, and by the considered opinion of those having operating experience of such plant, the future can be looked forward to with every confidence, and it is not premature to say that before long the rectifier will become a formidable rival to the existing forms of rotating converters.

Fundamental Considerations.—The mercury arc rectifier is a converter for transforming alternating current into direct current. The mercury arc when operating in a vacuum has the peculiar property of permitting the passage of a current in practically one direction only, this having been demonstrated for many years in the small glass bulb rectifiers introduced by Mr. Cooper-Hewitt, to whom must be given the credit for the discovery that this valve action was possible.

Of the molecular or physical nature of the arc very little is definitely known. The study of the subject is an extremely difficult one, and no tangible explanations can be given for many of the phenomena connected with it. When dealing with large currents the difficulty is increased, due to the necessity of confining the arc to well-defined paths by means of cylindrical steel guides, and hence direct observation is almost impossible.

An interesting photograph is shown in fig. 1 of the mercury arc in a small glass tube rectifier. The arc raises the temperature of the anode evenly over its whole surface to that of red heat, giving it the appearance of having a halo around it. At the cathode it centres in one spot, the crater, the temperature of which is raised to 2,000 deg. C. or over, corresponding to that of white heat. This cathode spot travels irregularly at high speed over the surface of the mercury, and gives off an intense metallic vapour, a portion of which forms the conducting medium for the current. The major portion of the space between the electrodes is occupied by a luminous column starting close up to the anode and extending downwards to within a short distance of the cathode, where it stops abruptly, leaving a dark space. With very high vacua it is noticed that a large negative flame rises from above the cathode, and this is one of the undesirable features in rectifiers.

To account for the above phenomena the following explanation has been adduced *:—

In gases, electricity travels in charges called ions. There are positive ions which are combined with the chemical atom, and negative charges or electrons which have no weighable mass. On the other hand, there are neutral molecules possessing charges of both kinds. To bring these different elements into action a point on the cathode surface is brought to white heat by suitable means, which produces electrons. These electrons under the influence of the electric field, travel with acclerating speed towards the anode, and after accumulating sufficient kinetic energy come into violent contact with the neutral molecules. The impact separates these molecules into their constituent positive and negative charges (termed "ionisation by shock"), at the same time raising the conductance of the vapour path. The newly formed positive ions, together with the existing ones, move with great speed towards the cathode, and heavily bombard it on a very small surface, which is thereby brought to white heat, and so the discharge is maintained. It should be emphasised that in accordance with this theory the formation of an arc depends mainly on the existence of electrons such as are produced at the cathode when brought to white heat and when under the influence of an electric field. To prove this, the following test can be made:—

The upper portion of fig. 2 shows an exhausted glass tube having one iron or graphite electrode A, and two mercury electrodes B and C. It is desired to produce an arc between A and B. By tilting the tube contact can be made between B and C by the mercury running from one to the other. On the tube being brought back to its original position an arc will be started at the point of rupture with B as the cathode, and thus the first necessary condition has been fulfilled, that is to say, a spot on the cathode surface has been brought to a white heat. From a consideration of the connections it is apparent that B can be either anode or cathode, depending upon the way the connections are made. It will, however, be found that if A is negative and B positive an arc cannot be started between them even though the pressure be raised to thousands of volts, whereas if the polarity is reversed only 20 to 30 volts is necessary to start the arc. It is only under these circumstances that the electrons can ionise the space between A and B. Referring to the ignition circuit, it should be stated that an arc cannot be produced between the main electrodes if when the ignition arc was started B was positive and C negative. The production of an arc between the elec-

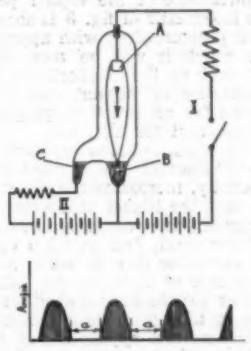

Fig. 2.

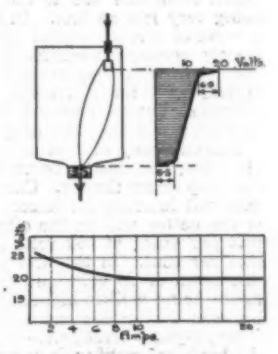

Fig. 3.

trodes A and B is therefore only possible if the main mercury electrode is a cathode, because it is only at the cathode that the electrons can be produced.

From the foregoing it will be gathered that the mercury arc operating in the manner described constitutes an electric valve, that is to say, it only permits the passage of a current in one direction. Electrons cannot be produced on a cold electrode, and it was shown with regard to fig. 2 that current would only flow provided the highly heated electrode was a cathode. To prove this—replace circuit I by an alternating current supply, and it will be found that an arc is only formed if A is positive and B negative, the result being a current wave similar to that in the lower portion of fig. 2. It should not be assumed that the spaces a without half-waves represent a loss of energy, because during these periods the valve passes no current, and therefore no energy is lost. It

* See *B.B.C. Review* No. 5, 1919.

has, however, been ascertained by special measurements that a very minute current amounting to a few milli-amperes does actually pass in the reverse direction, but this has no detrimental effect on the operation of the rectifier.

The temperature of iron anodes can be allowed to reach red heat without the valve action being endangered, though it is essential that the vacuum be kept as high as possible, for only then will the arc form as a halo round the anode without over-heating or vaporisation taking place on its surface.

Losses in the Arc.—To arrive at the losses occurring in a rectifier it is necessary to know the pressure drop in the arc. This is the sum of three separate drops due to the anode, the cathode, and the arc itself. The drop in the electrodes is practically constant, and is independent of their composition, the current density, or the vacuum. For iron anodes it is 6.5 volts, and for a mercury cathode 5.5 volts, making a total of about 12 volts.* The drop in the arc, however, is very variable, and depends upon the vacuum, the current density, and the section of the arc. It is directly proportional to the vacuum and inversely so to the current density and arc section. If we take a long tube of small section with a vacuum of 1 to 2 mm. Hg through which 3 to 5 amps. is passing, the drop would amount to 0.8 to 1.2 volts per cm. of arc length,

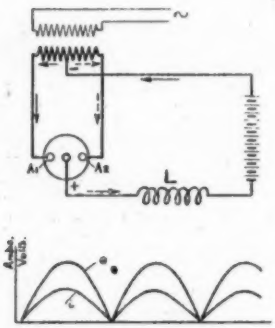

Fig. 4.

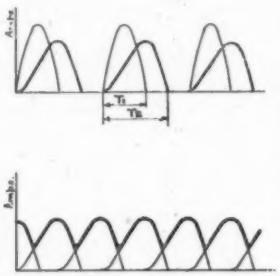

Fig. 5.

but in large rectifiers where the vacuum is very much higher, the section of the arc greater and the current density amounts to several hundred amperes, the drop is reduced to 0.1 volt per cm. and below.

Assuming an arc 80 cm. long, which is that applicable to the largest rectifiers, the drop would be that due to the electrodes—12 volts, and that due to 80 cm. of arc at 0.1 volt per cm.—8 volts—or a total of 20 volts. This is the pressure required to maintain the arc, and is shown graphically in the upper half of fig. 3, the almost horizontal portions of the curve relating to the anode and cathode, while the steep portion joining the two refers to the arc. For ignition purposes a higher pressure must be used to overcome the high initial resistance due to the conductance of the vapour path being very low at first. In the lower half of fig. 3 is shown a curve of current plotted against pressure drop with approximately constant vacuum, from which it will be seen that the curve falls very rapidly at first as the conductance increases with the increasing production of vapour, and then onwards remains constant, so that for all practical purposes it can be said that the drop is constant for all loads.

The efficiency of a rectifier, therefore, remains constant at all loads, the losses being the product of the current and the drop across the arc. Consequently, increasing the pressure does not increase the losses, so that the higher this pressure is the better will be the efficiency—at 220 volts this is about 91.6 per cent., at 550 volts 96.5 per cent., and at 1,500 volts 98.5 per cent. In the first two cases the drop is taken as a maximum of 20 volts and in the last at 22 volts, the latter figure being a little higher to allow for the increased distance between the anodes and cathode in high-pressure rectifiers.

Single-phase Rectifiers.—The commercial application of the single-phase rectifier is very limited in consequence of the highly pulsating direct current wave form produced. A consideration of the simplified connections and wave forms applicable to such rectifiers is, however, of importance, as the general principles are the same for both single and polyphase rectifiers.

The usual connections will be those given in fig. 4, from which it will be seen that the rectifier is provided with two anodes, while the secondary winding of the transformer is divided into two with its neutral point brought out to form the negative pole of the direct-current system. The cathode forms the positive pole of the system. The path of the current is from the transformer secondary to the anodes, thence by way of the arc to the cathode, and finally through the external circuit back to the neutral point of the transformer.

There would appear to be some doubt in the minds of many as to whether both halves of the alternating waves are fully utilised. The matter is very simply explained as follows:—

It has already been shown that the rectifier will only permit the current to pass in one direction. The transformer secondary windings are connected in such a manner that the current can only flow in that portion having an e.m.f. urging it through the external circuit to the neutral point, the rectifier being the only circuit through which it can pass, that is to say, with each half-wave the sense of the current is positive, and hence it can only flow from the neutral point towards the anodes. During the first half-wave the flow would be along the left half winding in the direction of the arrow towards the anode A_1, the right half winding during this period having no current flowing through it, while the anode A_2 would naturally be negative. With the second half-wave the polarity is reversed, due, as already explained, to the windings being arranged to always give a positive direction to the current, A_2 then becomes positive with the current flowing towards it through the right half winding, and A_1 becomes negative. It will thus be seen that both halves of the current waves are fully utilised.

This results in a unidirectional pulsating current similar to the pressure and current waves of fig. 4, the load being assumed to be non-conductive. It will be noticed that the current drops to zero at each half-period, which means that the arc would be extinguished and the supply interrupted because it only requires a cessation of the current for 1/100,000 of a second for the hot spot on the cathode to cool sufficiently to stop the formation of the necessary electrons. Some means, therefore, must be provided to prevent this occurring, the usual method being to have separate excitation in the form of an auxiliary arc supplied from an external source, though the desired condition can be obtained by the use of suitable choking coils (L in fig. 4). The part played by these choking coils is illustrated in fig. 5, from which it will be seen that the waves are flatter and prolonged from T_1 to T_2. If the current waves for the two anodes are added graphically, we obtain the result shown in the lower portion of fig. 5, in which the resultant current is always well above zero, and hence the supply is maintained. It will be easily understood that a direct-current supply of this nature could only be utilised for motors provided the momentary value of the rectified pressure is higher than the back e.m.f. of the circuit, which can be ensured by making the choker large enough.*

It is not proposed to deal at this stage in detail with the relative values of the current and pressure in single-phase rectifiers—suffice it to say that the transformer must on an average be designed for an output about 1.75 times the d.c. output. The matter will be dealt with in greater detail for the six-phase rectifier.

Polyphase Rectifiers.—When it is desired to transform two or three-phase current into direct current for lighting, general power, and traction purposes, the six-phase rectifier comes into consideration. In general appearance it is similar to the single-phase rectifier already described except that the number of anodes increases with the number of phases, whereas the cathode remains the same.

The simplest connections are represented by the diagram in fig. 6 which shows a six-phase rectifier fed from a three-phase supply through a six-phase transformer. When the source of supply is two-phase two transformers in Scott connection would be used. The same arrangement of the windings is followed for the transformer secondary, as has

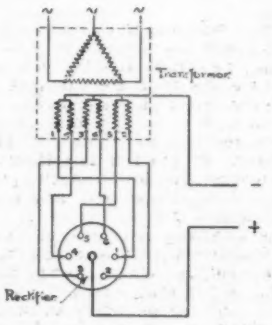

Fig. 6.

already been explained for the single-phase case, so that the current is always flowing from the neutral point towards the anodes. The use of a six-phase rectifier is decidedly satisfactory with regard to the resulting direct-current wave form, which is represented in fig. 7 by the heavy line joining the points of intersection of the half-waves, the load in this case being non-inductive. As indicated by the shaded portion, the individual anodes only carry current so long as the momentary value of the corresponding phase pressure exceeds that of the adjacent phases, that is to say, during one-sixth of a cycle. By the use of suitably designed choking coils, however, two or even three anodes can be made to carry current from different phases at the same instant, which results in a reduction of the peak currents and the prolongation of the

* See *B.B.C. Review* No. 5, 1919.

* See *B.B.C. Review* No. 5, 1919.

half-waves as was shown in the case of the single-phase rectifier. We therefore find that the amplitude of the undulation of the rectified wave form as compared with the alternating-current wave amounts to about 8 per cent., as against 60 per cent. in the single-phase rectifier.*

Relationship of Current and Pressure in Polyphase Rectifiers.†—A fairly definite relationship exists between the direct current pressure and the transformer secondary phase pressure, this being given for a six-phase rectifier by the simplified equation :—

$$\text{R.M.S. phase pressure, } e_p = \frac{V + \epsilon + (c \cdot e_a)}{1{\cdot}35\ k}$$

where V is the desired d.c. pressure, ϵ the drop in the arc, e_a the drop in the anode chokers, and c and k correction factors depending upon the connections adopted, while 1.35 is a constant giving the mean value of the pressure fluctuations above the points of intersection of the individual half-waves.

Taking a typical case in which it is desired to give direct current at 250 volts, we obtain :—

$$e_p = \frac{250+20+(1.2\times30)}{1.35\times0.97} = 234 \text{ volts.}$$

The drop in the anode chokers is taken at 30 volts, and that in the arc as 20 volts. The values 1.2 and 0.97 given to c and k have been obtained by experience. The transformer must therefore give 234 volts between the neutral point and its terminals to produce 250 volts on the direct-current side at normal load. Allowing for the regulation of the transformer, which is generally taken as double that obtaining with an ordinary alternating current having a 90 per cent. power factor, we arrive at an open circuit pressure that is considerably higher. If, for example, we assume the regulation to be increased to 6 per cent., the transformer open circuit voltage will be 248 volts. The corresponding rectifier pressure will be :—

$$Vo = (1.35\times0.97\times248) - 20 = 305 \text{ volts.}$$

There is a total drop, therefore, of 305−250=55 volts, giving an inherent regulation from no load to full load of 18 per cent. If such coarse regulation is inadmissible it can be considerably improved by interconnecting the windings of the anode chokers, which has the effect of changing the factor c in the equation from 1.2 to 0.2, resulting in a corresponding decrease

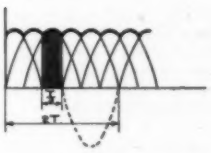

Fig. 7.

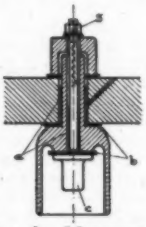

Fig. 8.—Mercury Seal, in Section.

of the overall regulation. Many forms of connections can be utilised, all giving different results to suit varying conditions.

Dealing now with the relationship existing between the two currents, we have the interesting result that for a polyphase rectifier the theoretical R.M.S. value of the phase current is equivalent to the total direct current divided by the square root of the number of phases or $I\text{ eff} = C/\sqrt{n}$; n being 6 for a six-phase case, $\sqrt{6}$ is therefore equal to 2.45. Taking a 1,000-ampere rectifier, the phase current would be 1,000/2.45 =408 amperes. In practice this theoretical value would be somewhat reduced due to the over-lapping effect produced by the anode and regulation coils which enables 2.8 to 3.5 to be taken instead of 2.45.

From the foregoing it is evident that the kVA rating of rectifier transformers must be higher than the corresponding direct current output. On an average the primary is designed for an input 20 per cent. greater to allow for efficiency and power factor, and the secondary an output 70 to 80 per cent. greater, making an increase for the whole transformer of about 1.5 times the direct current output.

To prevent confusion, it should be pointed out that though a larger transformer must be used it does not mean there is a corresponding loss of energy. The secondary windings may be said to be unfavourably utilised because of the larger section of copper that is required on account of the effective value of the phase current being high as compared with the direct current. This is due to each phase only dealing with half-waves. Hence it follows that the transformer must be a good deal bigger than one designed for normal purposes.

The transformer primary windings are invariably delta connected, though the star connection can be used when a regulation choker is connected in the neutral point. The explanation for this lies in the fact that without the choker alluded to the slight ripples in the direct current would react on the primary supply if the transformer were star connected, but by adopting the delta connection with its closed circuit the effect is largely damped out. The regulation choker still further smooths out the ripples and enables either form of connection to be used. For very high primary pressures, however, the transformers are always star connected.

The Construction of Large Rectifiers.—In the early stages of the development of the large steel rectifier many serious and almost insuperable difficulties were encountered, and the present production is the result of many years of patient experimenting, and the experience gained in actual practice with a number of installations on the Continent. The serious nature of these difficulties may be gauged by the fact that one well-known concern, after working for some time with little success, abandoned its manufacture, considering such rectifiers to be too unreliable and costly to compete with the usual rotating converters. To those endeavouring to reach a solution, the results obtained with the glass bulb rectifier were of little assistance, because when dealing with heavy currents the whole aspect of the subject changes. Broadly speaking, the difficulties that had to be overcome can be summarised as follows :—

(*a*) The manufacture of large cylinders that would be absolutely gastight.

(*b*) The electrodes had to operate satisfactorily at high temperatures without deterioration of the insulation.

(*c*) The possibility of internal short-circuits occurring had to be eliminated as far as possible.

*Sealing**.—When dealing with large cylinders consisting of a number of component parts, the difficulties of sealing are considerable, especially as a high degree of vacuum is essential to satisfactory operation. After trying many methods, the best results were found to be obtained by the use of asbestos packing and mercury, which together form a perfect seal. This form of seal has contributed very largely to the success of the Brown, Boveri rectifier, and is illustrated diagrammatically in fig. 8. It will be seen that the anode c is securely clamped against the asbestos washers b by the bolt s, while the mercury is poured into the spaces a surrounding the bolt and the anode insulator. The mercury completely fills up any irregularities in the surface of the materials with which it is in contact, and if the bearing surfaces for the asbestos are properly prepared and the washers well bedded, it is impossible for any air to percolate through. In justification of this it may be stated that the necessity for running the vacuum pumps after the cylinders have been completely exhausted is in general not because of any air that might leak inwards, but because of the gases that are given off at the anodes when well loaded. In fact, so satisfactory is the design that it is possible to maintain quite easily a vacuum equal to 0.01 mm. Hg.

(To be continued.)

* See *B.B.C. Review* No. 6, 1919.
† See *B.B.C. Review* No. 6, 1919.

THE ELECTRIFICATION OF A YORKSHIRE WOOLLEN MILL.

An interesting conversion from mechanical to electrical drive has recently been completed at Messrs. Rouse Bros'. Vale Mills, Oakworth, situated in an isolated and interesting part of the West Riding of Yorkshire.

These mills have utilised water power for driving their spinning and weaving machinery for upwards of 60 years.

The electrical equipment is unique, inasmuch as induction alternators are used to generate electricity from power supplied by the turbines. The use of generators of this type does away with complicated synchronising switchgear and the skilled attention which it demands. A glance at the main switchboard shown in fig. 2 will supply evidence of the simplicity for operation purposes.

The building containing the water wheel was completely dried out and made suitable for electrical machinery.

The new turbine plant (fig. 1) consists of three turbines, made by Messrs. Gilbert Gilkes, of Kendal, two taking water from the lower level supply and one from the higher. The lower level turbines are of the single discharge spiral-casing type, and develop 125 and 64 h.p. respectively on a head of 36 ft. when using 2,300 and 1,200 cu. ft. of water per minute, the speed being 428 and 600 r.p.m. The turbines are carried on cast iron combination bedplates and direct-coupled to the generators. The high fall turbine is of the double discharge twin runner type, and is arranged so that in periods of drought the water may be shut off from one runner, thereby enabling the other to be operated at a much higher efficiency. This turbine is also mounted on a cast iron bed and coupled direct to the generator. It is designed to develop 150 h.p. at a working head of 50 ft., using 2,000 cu. ft. of water per minute and running at 600 r.p.m.

It is interesting to note that there is no governor gear required, as the generators are run in parallel with the supply taken from the Keighley Corporation, and as a natural consequence, the speed is maintained constant. The simple manner in which these machines are put on circuit calls for special attention. First, the distributor vanes on the turbine are opened to allow sufficient water to pass to run the turbine

* See *B.B.C. Review* No. 6, 1919.

up to approximately synchronous speed. Secondly, the generator is switched direct on to the line, the vanes being opened fully out in order to allow the necessary amount of water to pass for the generator to develop its full output. This completes the operation.

Considerable difficulty was experienced in arranging the turbines in suitable positions without entailing excessive cost in altering masonry and pen troughs. This accounts for the peculiar angles at which the pipes run. Each turbine drives

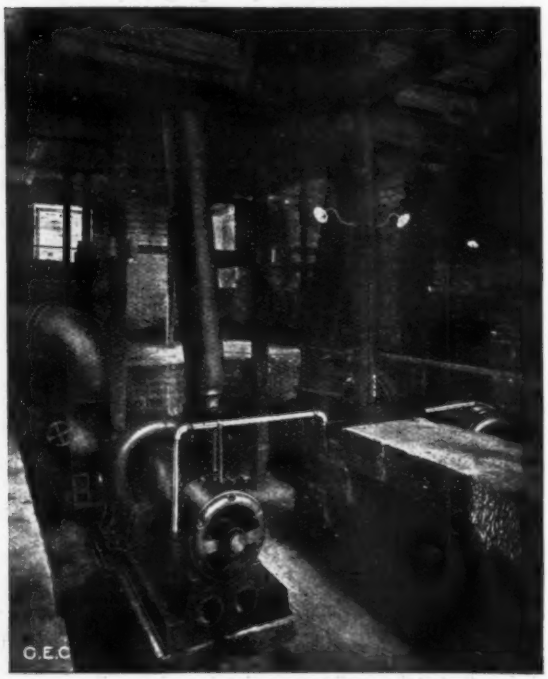

Fig. 1.—View of Hydraulic Turbo-alternators.

an induction type alternator, the outputs of which are 81 kW and 43 kW for the low level turbines, and 103 kW for the higher level machine.

In addition to the electrical power derived from hydraulic power, a certain amount is taken from the mains of the Keighley Corporation, this being stepped down from 6,600 volts to 400 volts, by three 250-kVA transformers, at which pressure it is distributed from the main switchboard (fig. 2) which controls the alternators. It comprises three alternator,

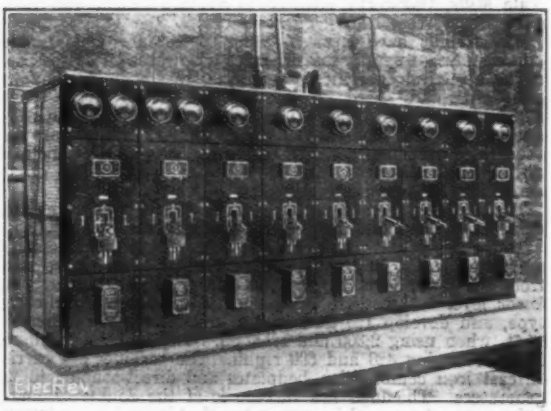

Fig. 2.—Main Switchboard.

two transformer, and four feeder panels. Each is equipped with an oil switch, energy meter, and so forth.

All the motors up to and including 60 h.p. are of the squirrel cage enclosed ventilated pattern running at 580 r.p.m.; above this size they are of the slip ring pattern. All the 60 h.p., 80 h.p., and 100 h.p. machines are fitted with third bearing shaft extension and are mounted on substantial cast iron bedplates.

The large weaving shed contains upwards of 100 looms. Six 25 h.p. motors situated in the roof drive two shafts each, while another shaft is driven by a 100-h.p. machine, the auto-transformer starters for these and the other motors in the mill being manufactured by Messrs. George Ellison, of Birmingham.

The contract for the electrification of this mill was carried out by the General Electric Co., Ltd., through its Leeds branch.

In conclusion, thanks are due to Messrs. Rouse Bros. for permission to take the photographs reproduced in this article, and to publish the particulars.

THERMAL CHARACTERISTICS OF ELECTRIC OVENS AND HOT-PLATES.

By EZER GRIFFITHS, D.Sc., and F. H. SCHOFIELD, B.A., B.Sc.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

The British Engineering Standards Association recently issued Standard Specification No. 106, 1920,* for electrically-heated cooking ranges. Among other requirements, certain thermal tests are prescribed which are based on experimental work carried out at the National Physical Laboratory in 1918. The present paper reviews the prescribed tests so that the reason for their selection may be understood. It is concerned with hot-plates and cooking stoves solely from the thermal point of view, and does not touch on other factors also dealt with in the specification.

For toasting or grilling, a high proportion of radiant energy is required, involving the use of bare resister elements at a red heat; for intermittent operations the lightly constructed plate or oven embodying a minimum amount of metal has obvious advantages, while for continuous operation the heavy plate or well-lagged oven is probably most suitable. The cooking appliances sent to the N.P.L. included 15 makes of hot-plates and eight makes of ovens, and seem to have been a representative selection of the various types.

Hot-Plates.

In testing hot-plates, conditions should correspond closely to those prevailing in practice. Ordinary cooking utensils are not sufficiently standardised to be used for quantitative tests; therefore, metallic disks of the same order of cross-section and thermal capacity were used for the purpose, and attempts were made to determine the effect of various surface conditions in the heat-receiving face. Experiments were also made with special cast-iron vessels containing oil.

Except where otherwise stated, the copper disk used was supported off the plate by steel pegs, and the surface of the disk was oxidised. The following results were obtained during the heating up of the plate:—

Temperature distribution was quite uniform for both the open and enclosed types of plate, except where the disk was larger than the heat-emitting area. In the latter case the outer edge of the disk lagged behind the centre. Copper disks of the same thickness but of different diameters were placed over an enclosed hot-plate of larger diameter. The watts supplied were approximately the same for the two experiments, and there is only a very slight difference between the rate of temperature rise in the two cases. This implies that the disk only absorbs the energy emitted from the area actually covered. The uncovered area radiates the heat into space, and there is but little transverse conduction across the top of the plate.

When supported off the hot-plate by the steel pegs the copper disk is heated primarily by radiation and by air conduction through an air layer. Convection in such a narrow horizontal layer would probably be of negligible magnitude. Hence the degree of oxidation of the receiving surface would exercise a considerable influence on the heat transfer by radiation.

Actually the coefficient of emission of an oxidised cast-iron plate is about 70 per cent. of that of a black body, while for oxidised copper the value 50 per cent. would be of the right order, but if the copper surface were cleaned up with emery paper its coefficient would probably be less than 10 per cent. So that the heat transfer for a given difference of temperature would only be one fifth that obtained with the oxidised surface. If account is taken of multiple reflections of energy between the two surfaces, the effect is to increase considerably the heat transfer by radiation.

Assuming the standard case of both surfaces being oxidised, and assuming an air-gap between them, then the heat transmitted by thermal conduction is greater than that by pure radiation. It has been repeatedly observed that the surface of the hot-plate was at a red heat (about 600 deg. C.) when the copper disk was in the neighbourhood of 300 deg. C. Radiation is the more important factor in the heat transmission under these conditions.

In the case of the open spiral types of hot-plates the conditions are somewhat different; the spirals are running at a steady bright red heat and the fireclay grooves are also at a fairly high temperature and, since the air-gap is considerably

* Elec. Rev., Aug. 13th, p. 212, and 27th, p. 263, 1920.

increased, it is probable that some convection occurs. Under these circumstances it would be expected that thermal conduction would be relatively unimportant compared with radiation and convection transfer.

Experiments were made with a closed-type plate to illustrate the influence of the surface condition of the receiving copper disk, and it was found that the effect of polishing the surface is to reduce considerably the rate at which the disk absorbs heat. Regarding the effect of metal contact between hot-plate and disk, oxidisation does not affect the rate of rise of temperature, and consequently it may be presumed that the two surfaces were in sufficiently intimate contact to prevent oxidation of the receiving face of the disk. For other experiments the copper disk was raised with the three steel pegs; the time required to heat up to 200 deg. C. was reduced from about 13 to 6 minutes, by placing the surfaces in close contact.

Some typical results obtained with the copper disk are set out in Table I. "Efficiencies" give the ratio of the heat absorbed by the disk, *i.e.*, the heat capacity of the disk multiplied by the temperature-rise of 100 or 200 deg. C., to the energy supplied to the hot-plate during the time interval taken by the disk to rise 100 or 200 deg. C.

The results of these experiments bring out two important points. First, while the interposition of an air-gap by means of pegs makes the contact conditions reproducible, it has the disadvantage that the conditions are of a different character from those in actual practice, and this may operate unfairly against the hot-plates with machined surfaces compared with the radiant types.

Secondly, the disk has a very small thermal capacity, being equivalent to only 0.18 pint of water.

TABLE I.

	Open type	Closed type
Mean watts	1,085 to 1,400	910 to 1,150
Time to rise 100° C., min. ...	4.2 to 5.6	9.0 to 11.1
Efficiency, per cent.	10.0 to 12.1	4.8 to 6.4

Further experiments were made with thick mild steel disks, and it was ascertained that the uniformity of the temperature over a plane of the disk was quite satisfactory and that, therefore, the mean temperature could be obtained by observations with a thermometer, which is probably more convenient for general use than a thermo-couple.

The heat capacity of this disk was equal to 1.6 pints of water, while a similar copper disk had a rather larger capacity. Some typical results obtained with these disks are given in Table II. As before, the "efficiencies" are taken to be the ratio of the heat absorbed by the disk to the energy supplied to the hot-plate. The efficiency for the complete run to the maximum temperature attained by the disk after the energy is switched off is greater than the efficiency during heating since, for some time after switching off, heat will continue to flow into the disk.

TABLE II.

	Open type	Closed type
Mean watts	1,420 to 1,550	730 to 2,570
Time to rise to 200° C., min. ...	24.75 to 25.58	15.33 to 25.92
Efficiency during heating, per cent.	27.6 to 30.3	26.8 to 60.2

Experiments were made with two cast-iron vessels supplied by the British Engineering Standards Association. The bottom surfaces had been machined up, but were not quite true, and cotton-seed oil was used as the liquid. The time-temperature curves for repeat experiments were not as concordant as those with the disks. This may be due to variable thermal contact between the bowl and the surface of the hot-plate, and to some extent to inefficient stirring. Calculations of the efficiencies of the hot-plates have been made on the basis of the above experiments, and are given in Table III. It is assumed that the bowl is at a uniform temperature throughout, and that the specific heat of the oil is 0.5.

TABLE III.

	100° C. rise	Full run
Efficiency open type, per cent. ...	27.4 to 29.8	31.8 to 33.4
Efficiency closed type, per cent.	35.5 to 42.7	45.2 to 53.4

Cooking Stoves.

The efficiency of an oven should consist in the determination of (1) the number of electrical units required to bring the temperature of the interior to the maximum within a certain period, (2) the energy required to keep it at the minimum temperature necessary for cooking operations. In the first instance thermo-elements of iron-constantan were employed with the hot junction formed of very thin sheets of oxidised copper foil; the thermometric lag of this form of pyrometer is practically negligible.

In the case of an oven which took 12 minutes to reach a temperature of 200 deg. C. from cold, the mercury thermometer lagged about 20 deg. C. behind the thermo-element, and for an oven taking 40 minutes to reach 200 deg. C. the lag was only 5 deg. C.

To obtain the average temperature of the volume in the centre of the oven experiments were made using a hollow copper sphere with the two wires of the couple soldered to the top and bottom hemispheres respectively. The results of a comparison with a disk thermo-element showed that the sphere lags behind the disk by about 25 deg. C. in the case of an oven taking about 16 minutes to reach a temperature of 200 deg. C. This lag could be reduced by making the sphere of thinner metal; the indications of the spherical form are independent of the orientation. Further experiments were made with special mercury thermometers of the nitrogen-filled type. It was found that the differences obtained for the various sized thermometers commercially obtainable were almost negligible compared with the lack of uniformity in the oven. However, to ensure reproducibility the size of the thermometer is specified.

The distribution of temperature differs considerably in the different types of ovens according to the distribution of the heating units.

No general rules can be laid down for the distribution of temperature, and it would be impracticable to attempt an integration to obtain the true mean temperature. It will probably suffice for comparative tests to take the readings given by a single thermometer projecting into the centre of the oven.

TABLE IV.

Light ovens, air-gap insulation: 570 to 785 watts; kWh per cubic foot to raise to 200° C., 0.319 to 0.350.
Light ovens, air-gap insulation: 1,210 to 1,990 watts; kWh per cubic foot to raise to 200° C., 0.222 to 0.585.
Heavy ovens, lagged: 2,065 to 2,590 watts; kWh per cubic foot to raise to 200° C., 0.389 to 0.696.

The procedure in making a test was to run the oven at "full heat" to the temperature desired and then to reduce to the medium or low heat by means of the switches provided with the oven. This corresponds more closely to what occurs in practice than the determination of the energy necessary for a series of equilibrium temperatures. The data obtained are summarised in Table IV. The lagged ovens, usually of heavy construction, require from 1 to 1½ units to raise the temperature to 200 deg. C., but are very efficient when working at a steady temperature if account is taken of the cubic capacity in relation to watt supply. Most of the ovens tend to remain at a very steady temperature when switched on to medium heat.

Thermal Insulation of Ovens.

The thermal efficiency of an oven depends largely on the provision of suitable insulation. Taking a freely exposed vertical surface as being, on the whole, most typical of oven walls, the curves connecting convection loss and temperature difference illustrate the importance of employing surfaces of low radiating and absorbing power. Thus for a temperature excess of 100 deg. C. above the surroundings, the heat loss of a surface with a 10 per cent. coefficient will be only about one-half of that of a black body. To give some idea of the range of coefficients for common materials the following rough values may be given. Paints* of all colours and surfaces (from matt to enamel) 80 to 90 per cent., oxidised metal surfaces 50 to 90 per cent., dull metal surfaces 20 to 40 per cent., polished metal surfaces 3 to 10 per cent. It is out of the question to use highly polished metal surfaces in oven construction, but the use of clean unoxidisable surfaces often adds considerably to the efficiency. In the case of ovens with thin solid walls (generally metal), the heat loss will be governed entirely by the surface "resistance," but in the case of an oven with a double metal wall with air-gap the heat loss can be shown to be rather less than one-half of that of the single wall, for the convection loss between two parallel faces "boxed in" at the top and bottom is considerably smaller than for a plate with free access of air and the same temperature difference.

Regarding ovens with two metal walls and insulating material between them, x being the thickness of the insulating material, if $x=2$ cm. the heat loss will be about the same as for the double-walled oven with air-gap. If, however, $x=5$ cm., it will be a little more than one-half of that of the double-walled oven with air-gap.

The above illustrations give some idea of the factors affecting the transference of heat through oven walls when the steady state has been reached, such as in an oven run continuously. But this is not often the case in practice. It is more common for an oven to be switched on when cold, used for some cooking operation, and then allowed to cool again. In these circumstances the heavily lagged oven, although more efficient in continuous running, may be at a disadvantage. Its greater heat capacity will cause energy to be wasted in heating up the mass, and it will take a longer time to reach its maximum temperature. Temperature curves for the air in the oven, and for the interior and exterior walls show that while the air and internal wall reach their maxima in less than 50 minutes, the exterior wall took over 100 minutes to reach its steady condition. This means that, for the last-mentioned period, energy is still being absorbed in heating the walls of the oven. The curve obtained when heating up the oven and determining the watts required to keep it steady at a series of ascending temperatures, and the curve obtained for a series of descending temperatures differ, because for the

* A metallic paint such as aluminium paint is an exception, having a coefficient of about 50 per cent.

ascending part of the cycle, heat is flowing into the walls when the air in the oven is kept constant, and *vice versa* for the descending part.

Discussion in London.

Mr. J. W. Beauchamp, who opened the discussion, which was not intended to be confined to the subject dealt with in the paper, but to cover electrical appliances for domestic purposes generally, thought the paper would be a very useful one for reference purposes. The efficiencies of the various types of appliances did not differ very materially; efficiency really depended upon the operator, that was, on the size of cooking utensil used and on the art with which the switches were manipulated. Under present conditions the switches provided were not used to anything like the extent or manner in which they were intended to be used. The need for demonstration was, therefore, very evident, and until users had been taught how to use electrical appliances properly the best results would not be achieved. It should also be remembered that the use of the oven for roasting and baking was a small fraction of the total cooking operation which was carried out by means of hot-plates, &c. In that connection, the speaker did not think the last had been heard of immersion heaters. Such heaters when constructed of the proper shape to be easily cleaned would be found to be exceedingly useful and efficient devices. The paper had proved to be very useful to him, and he was sure it would be equally useful to manufacturers of electric heating and cooking apparatus.

Mr. H. H. Berry characterised the excellent work described by the authors as unique; the paper was a record of facts. Nevertheless there were other equally important facts to be considered which he regretted had been omitted. He then proceeded to outline his well-known system of maintaining a constant temperaure (equally applicable to the heating of rooms, water, ovens, hot-plates, &c.) by means of one fire burning a cheap fuel, and "topping up" by means of electricity to any higher temperature as and when required. The complaint that central heating caused houses to become "stuffy" and oppressive was justified, because the constant temperature maintained by such systems was usually much higher than was necessary.

Mr. W. A. Gillott criticised the tests outlined by the authors on the ground that they did not represent the true conditions obtaining in the domestic use of the appliances. He thought their first aim should be to standardise nomenclature; for example, a "hot-plate" was really a boiling plate, and what was termed a "cooking range" was no more than an oven. The tests had been carried out from a laboratory standpoint, and they had no commercial value. Why could not the tests have been made under ordinary domestic conditions? In his opinion a better line on which to work would be to show that a device could be relied upon to do a certain amount of work in a definite time. Special utensils were now obtainable for use with electrical cooking devices, and it should be remembered that the object was not to heat a surface uniformly or otherwise, but to cook the contents of the vessel. With regard to ovens, no indication was given in the paper of which was the best type of heating element to use; his opinion was that the elements should be placed on the sides of the oven, they should be very robust, and unaffected by extreme temperatures. In designing an oven the first consideration should be rapidity of heating up to cooking temperature.

Mr. W. R. Cooper confessed that he had failed to understand the true meaning of the figures for efficiency which the authors had given. The methods adopted for the tests were condemned by the results which had been obtained, which contradicted each other. He was not in favour of the use of disks standing on pegs because the layer of air thus introduced between the disk and the hot-plate would alter the conditions. It would be preferable to place the disk in direct contact with the hot plate, but it was of very little use attempting to work to any great accuracy in such tests. The use of oil would alter the conditions because it would result in too high a temperature being reached, and the best method to adopt would probably be to use an ordinary cooking vessel and boil in it a definite quantity of water.

Mr. H. T. Harrison protested against the criticism which had been made as he thought the paper contained useful data and would be a valuable one for reference purposes. At the same time the authors had made several assumptions which they had no right to make. For instance, the shape of the ordinary vertical oven, which took as its model the gas-heated oven, was quite wrong; the correct shape was one in which the breadth and width were large compared with the height. Moreover, why were ovens always constructed of a material which conducted the heat away and then lagged in order to retain a portion of the heat? He had used for many years an oven in the construction of which no metal whatever had been used. Another point to be remembered was that in many establishments the same cooking vessels were used for cooking by coal fire, gas, or electricity, and such utensils were usually not merely oxidised, but actually coated with a thick deposit of carbon. The need for instruction in the proper use of electrical domestic devices was apparent; and it should always be remembered that the electrical method should not be advocated on economical grounds, but on account of its cleanliness and convenience.

Mr. P. Good criticised the use of the word "efficiency" by the authors, and thought that a better idea of their meaning would have been conveyed if they had used some other term. It was a matter of the greatest difficulty to devise tests which could be repeated with accuracy; he had seen much of the work in progress at the N.P.L., and many of the results which had been "boiled down" into the paper, and he congratulated the authors on their achievement. The future development of the application of electricity to domestic purposes would depend largely on standardisation; interchangeability of such things as wall plugs, &c., although small in themselves, would exercise considerable influence and their standardisation would be very helpful. What they wanted was apparatus, together with accessories and component parts, which was interchangeable and capable of being moved from room to room, or house to house, as was the case with gas-heated devices.

Prof. E. W. Marchant said that some of the points he had intended to raise had been covered by Mr. Cooper's remarks. He criticised the use of the word "efficiency," and described the tests as unfavourable ones, but thought the apparatus was not actually as bad as would appear from the authors' results. He had caused some tests to be made by his students by boiling an ordinary kettle on an electric hot-plate, and they had found that with a kettle having a clean bottom and one-quarter full of water, the efficiency was 40 per cent., and when full 52 per cent. When the bottom of the kettle was candle blacked the efficiencies were respectively 32 and 40 per cent. Surely they could devise tests and present the results in such a manner as would give a clearer indication of what the apparatus was really capable of doing than had been done in the paper?

Mr. C. G. Nobbs, speaking as a manufacturer, explained that most tests relating to heating and cooking devices were very indefinite, but the authors had given them figures which could be trusted, because they knew exactly how those results had been obtained. Immersion heaters were the best means of heating water electrically; the air temperature within an oven was very variable, and he thought that if during the tests a bulk equal to the object to be cooked had been placed inside the ovens the results obtained would have been very different.

Mr. A. F. Berry pointed out that it was very difficult to determine what the efficiency of a particular oven was; the objects to be cooked in an oven varied greatly, and there were a whole lot of cross elements that had to be considered. Considering the complexity of the subject he thought the authors had tackled it valiantly.

Prof. J. T. MacGregor-Morris pleaded for instruction to be given on the proper use of domestic electrical appliances; printed instructions were of little use, they were rarely read and still more rarely remembered. Turned cast-iron utensils were undesirable because they soon got into bad condition, and an essential point about electric cooking was reliability. He had used electricity for that purpose for 15 years, and had found that the cost of element renewals was a serious item; if he had not been an electrical engineer he would have abandoned electric cooking long ago. Little details which might appear of no consequence to an electrician were really very serious in the eyes of the user who knew nothing about electricity, and it was just those details that needed improvement and on which the future of the whole subject would depend.

Mr. E. T. Williams was of the opinion that the problem had been considered too much from the engineer's point of view; on the other hand, the housewife looked at the bill. It was of little use to rely on cooks and housemaids to manipulate the switches properly, and the only remedy would be the incorporation of a simple form of thermal switch in the oven. Such a device would go a long way towards satisfying the housewife's point of view. Undoubtedly the best form of propaganda was to install the device in the house, and after demonstrating how it should be used, the housewife should be allowed to use it herself for a period. If that method were tried he was sure the device would be retained in every case. He favoured some form of central heating by which the temperature could be "topped up" as outlined by Mr. Berry. During the spring and autumn some artificial heating was often required in the morning and evening, but not during the day time, and under those conditions electric radiators were most suitable and cheaper than coal fires.

A speaker, whose name was missed, explained that in an "all electric home" three-quarters of the electricity consumed would be used in heating water. Under those conditions the cost would be prohibitive, and the whole problem, therefore, rested upon the development of some form of cheap and efficient water heater.

Dr. E. Griffiths, in briefly replying to the discussion, pointed out that the disks used in the experiments had a thermal capacity equal to a certain quantity of water; the conditions, therefore, were easily comparable. Immersion heaters were excellent for heating water and other liquids, but they had been set a definite task, and the results obtained were set out in the paper. They always did what they were asked to do to the best of their ability, and if they were asked to elaborate the investigation they would have much pleasure in rendering assistance.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A British Washing Machine.

Electric washing machines that have hitherto come to our notice depend upon the effect obtained by enclosing the articles to be washed either in a cylindrical container which rotates in water, or in a circular container fitted with a revolving or oscillating dolly which rubs the clothes.

Messrs. Napier-Kimber, Ltd., 109, Great Portland Street, W. 1, have produced a washer (fig. 1) in which the washing effect is obtained by enclosing the articles to be washed in a container to which a vertical reciprocating motion is imparted with a frequency of 30 to 50 complete oscillations per minute, the sides of the container being so designed as to ensure a rapid and forcible flow of water in and out of the container, and therefore through the articles at each oscillation.

The container, which is rectangular in shape, is suspended at the ends of two arms which are attached at their other ends to a rocking shaft. This shaft is mounted near the top,

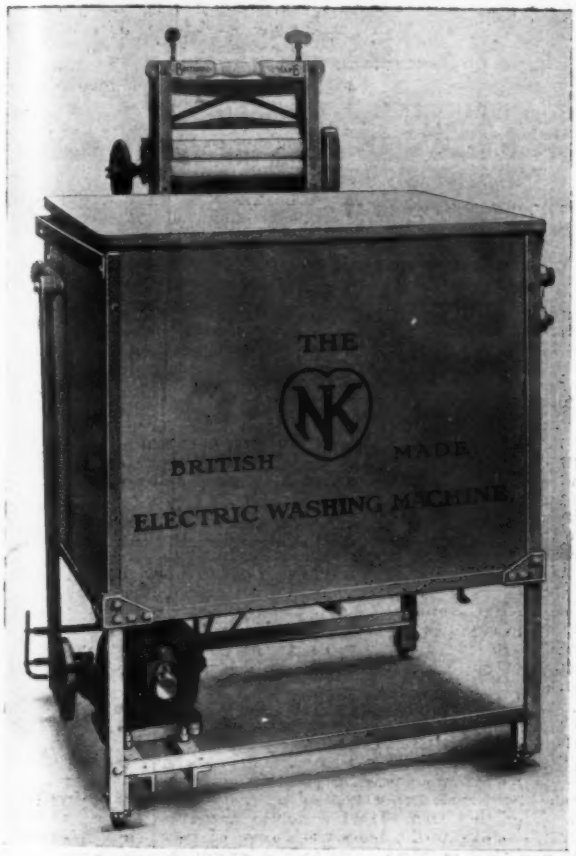

Fig. 1.—The Napier-Kimber Electric Washer.

and at one side of the rectangular tank projects two inches. A lever is attached to one end of the overhang, and at the other end to a connecting rod which runs on a crank pin attached through a dog clutch to the low speed shaft of an electrically-driven worm gear. A wringer is mounted on one side of the tank and driven from the same shaft as the washing mechanism. A dog clutch is provided here also so that it is possible either to run the washer or the wringer separately or both together, as may be desired.

The wringer is driven by means of a round belt, the tension of which can be adjusted so that it will slip at a load below that which involves an overload on the motor, and the belt tightening arrangement consists of a pair of jockey pulleys mounted on the end of a pivoted arm, the pivot end of which is capable of revolution about the same axis as the driving pulley on the main low-speed shaft. It is thus possible to obtain a vertical belt drive to the wringer, while at the same time keeping the whole of the vital portions of the mechanism underneath the tank, and thus avoiding the risk of splashing.

Apart from a main double-pole switch and fuse controlling the motor itself the control of the machine is effected by Bowden wire mechanisms operating on the washer and wringer clutches respectively. The machine is of British manufacture throughout.

A Novel Bowl Clip.

The usual method of suspending bowl fittings in lighting installations is by means of a ring into which the bowl drops. This, of course, necessitates a stock of rings of various sizes, and probably a different size for each bowl. An extremely simple but at the same time efficient device to supplant this

Fig. 2.—The "Levahook" Clip.

method of suspension has been produced by Messrs. Henry G. Richardson & Sons, flint glass manufacturers, Wordsley, near Stourbridge. This is the small combined hook and clip illustrated in fig. 2. The "Levahook," as it is aptly named, consists of a bent lever of cast brass, the top part of which

Fig. 3.—Application of Clips.

it hooked for the reception of a chain while the other end fits against the inside of the bowl. The rim of the bowl is then held by the pivoted hook seen in the illustration, and the weight of the bowl keeps the fitting closed. It will be seen that the greater the weight of the bowl, the more effectively is it held by the fitting. Any size or shape of bowl can be fitted with this clip. A patent is being applied for. Fig. 3 shows the fitting applied to a suspended bowl.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 885, High Holborn, London, W.C. 1.

3,467. "Electric switches." C. Hyland. January 28th.
3,470. "Adaptors for electric lighting, &c., circuits." F. Young. January 28th.
3,473. "Blocks for securing ceiling-roses, electric light switches, gas brackets, &c., to walls and ceilings." G. H. Easter. January 28th.
3,474. "Electrical heaters." J. R. Quain. January 28th.
3,480. "Method of cleaning sparking plugs." J. Chabrolle. January 28th. (France, January 29th, 1920.)
3,482. "Joints for electric conductors." W. C. Bailey and London Electric Supply Corporation, Ltd. January 28th.
3,483. "Sound receivers." Signal Ges. January 28th. (Germany, October 16th, 1920.)
3,489. "Electrical instantaneous water-heater." E. Caselli and E. C. R. Marks (Caselli). January 28th.
3,492. "Arrangement for doubling number of periods in electro-dynamo vibrating devices for sound transmitters, &c." W. Kunze. January 28th.
3,507. "Delay-action devices employing thermionic valves." N. Lea and Radio Communication Co., Ltd. January 29th.
3,528. "Electro-plating barrels, dipping baskets, &c." F. R. Tubbs. January 29th.
3,534. "Electric head-lights for vehicles." R. Bosch Akt.-Ges. January 29th. (Germany, November 26th, 1920.)
3,535. "Relay for amplification of electrical energy." D. H. Fehr. January 29th.
3,540. "Apparatus for recording telephone calls." A. D. Ickringill. January 29th.
3,576. "Automatic variable resistance with single rheostat for printing kinematographic negatives." L. Lobel. January 29th. (France, February 3rd, 1920.)
3,577. "Incandescent electric lamps, and methods of manufacturing same." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. January 29th.
3,578. "Means for making and breaking electric circuits." F. M. Brown and A. E. Davies. January 29th.
3,596/7. "Motor vehicle lamps." W. H. Eggington & H. Lucas. January 29th.
3,610. "Automatic variable resistance with single rheostat for printing kinematographic negatives." L. Lobel. January 29th. (France, September 27th, 1920.)
3,266. "Illuminating systems for vehicles." S. V. Gramlich. January 26th.
3,268. "Sound amplifier." W. F. Smith. January 26th.
3,275. "Brakes for cableways." S. A. Rogers. January 26th.
3,618. "Combined electric starting, lighting, ignition, and warming system for motor cars, &c." R. H. Playfoot. January 31st.
3,626. "Electric rectifying device." A. Day and J. C. Robertson. January 31st.
3,647. "Instrument for conveying sound to the deaf." A. L. J. Belasco. January 31st.
3,648. "Adjustable anti-vibrator for electric lamps." H. Clayton. January 31st.
3,665. "Brush-holders for dynamo electric machines." E. H. H. Hassler. January 31st.
3,677. "Automatic electric switches." H. W. F. Ireland, H. Lucas, and O. Lucas. January 31st.
3,678. "Sparking plugs." T. J. Puplett. January 31st.
3,683. "Magneto-ignition apparatus for internal combustion engines." Scintilla. January 31st. (Switzerland, February 4th, 1920.)
3,685. "Electric furnace regulators." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. January 31st.
3,693. "Telegraph and telephone systems." I. Hortix. January 31st.
3,699. "Means for recording telephone calls." A. W. Wood. January 31st.
3,704. "Process of carrying out to the limit incompletely proceeding reactions." H. Arnold and T. Goldschmidt Akt.-Ges. January 31st. (Germany, February 7th, 1920.)
3,709. "Wireless telegraph calling or alarm devices." T. D. Parkin. January 31st.
3,718. "Spark plugs." P. J. Donavan. January 31st.
3,720. "Electric fly switches." A. J. Bonella. January 31st.
3,733. "Machine for taking soundings from submarines, &c." C. I. Cockin. February 1st.
3,734. "Device for testing sparking plugs." F. Greenhalgh and J. J. Jennison. February 1st.
3,739. "Means for coupling electric cables, &c." G. Andrew and F. H. Wilkinson. February 1st.
3,744. "Gripping device for electric lamp holders, &c." J. Ashworth. February 1st.
3,774. "Apparatus for indicating and recording speed and number of movements of mechanism, applicable also as distance indicator for road vehicles." G. J. Gibbs. February 1st.
3,777. "Automatic, &c., telephone systems." W. Aitken. February 1st.
3,802. "Manufacture of commutators of dynamo electric machinery, &c." L. Neal. February 1st.
3,805. "Head lamps for vehicles, &c." H. C. Gibson. February 1st.
3,809. "Electric generating plants or systems." Cutler-Hammer Manufacturing Co. and Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). February 1st.
3,810. "Alternating current commutator motors." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. February 1st.
3,820. "Electrical heating of buildings, &c." J. R. Bayley, K. G. Maxwell and Metropolitan-Vickers Electrical Co., Ltd. February 1st.
3,829. "Electric starters, for internal combustion engines." E. R. Elliston. February 1st.
3,831. "Means for obtaining electricity from the atmosphere." H. Gough-Turner. February 1st.
3,834. "Terminal plate for electrical and engineering purposes." J. Laird. February 1st.
3,855. "Sparking plug." C. A. West. February 2nd.
3,861. "Burglar alarms." N. Reeves. February 2nd.
3,863. "Cab signal for railway trains." L. W. Madge. February 2nd.
3,867. "Controlling, starting, &c., apparatus for electric generators and/or motors." T. H. M. Swinburne. February 2nd.
3,884. "Electrically operated machines for riveting, pressing, stamping, &c." R. M. Taylor. February 2nd.
3,892. "Combined electric plugs or holders and circuit breaking devices." L. Poncet. February 2nd.
3,906. "Submersible electrical machinery." E. L. W. Byrne. February 2nd.
3,907. "Travelling platform for termini of electric tramway systems." C. R. Thompson. February 2nd.
3,909. "Telephone repeaters." Western Electric Co., Ltd. (Western Electric Co., (Inc.). February 2nd.
3,916. "Electric switches." A. H. Cornish, Petters, Ltd. and H. S. Saunders. February 2nd.
3,919. "Electric liquid heaters." Festa Akt.-Ges. February 2nd. (Germany, February 11th, 1920.)
3,927. "Electro-mechanically controlled telephone system." F. Aldendorff and H. Baron (Aldendorff). February 2nd.
3,928. "Electric switches." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. February 2nd.
3,932. "Electric arc welding." International Welding Engineering Corporation, A. E. White (International Welding Engineering Corporation). February 2nd.
3,946. "Sparking plugs." J. C. Milne. February 2nd.
3,962. "Portable electric hand lamps." G. W. Richards. February 2nd.
4,019. "Magnetically operated device for indicating or controlling changes of level, &c." R. H. Barbour and Electrical Apparatus Co., Ltd. February 3rd.
4,044. "Arc lamp carbon holders." W. van den Broeck. February 3rd.
4,045. "Means for indicating direction to aircraft during fog." J. T. Babington. February 3rd.
4,055. "Portable accumulators." J. W. Cook. February 3rd.
4,057. "Electric switches." C. L. Arnold and C. R. Belling. February 3rd.
4,058. "Relays, amplifiers, and high-frequency signalling receiving apparatus, &c." P. R. Coursey and H. S. Pocock. February 3rd.
4,062. "Electric motors, &c." J. V. Brittain and F. E. Harris. February 3rd.
4,068. "Semi-direct electric light fittings." S. D. White and F. Winstanley. February 3rd.
4,089. "Sparking plugs." A. H. Fynn. February 3rd.
4,091. "Electron discharge apparatus." General Electric Co., Ltd., and C. F. Trippe. February 3rd.
4,093. "Charging hoppers for electric furnaces." E. E. D. Edlundh, E. C. Beck-Friis, and C. I. Thorssell. February 3rd.
4,118/9. "Electric transformers." O. Imray (Pittsburgh Transformer Co.) and Pittsburgh Transformer Co. February 3rd.
4,120. "Electric plug switches, switch fuses, &c." H. F. Shanahan. February 3rd.
4,121. "Thermionic valves for wireless telegraphy and telephony." B. Hodgson, S. R. Mallard, L. G. Preston, and G. Shearing. February 3rd.
4,131. "Anti-dazzle device for electric motor lamps." N. Kemp and W. H. Kemp. February 4th.
4,156. "Electric thermostats." E. P. Barfield and L. W. Wild. February 4th.
4,157. "Signalling." W. H. Crabb. February 4th.
4,169. "Dead cable indicator." H. McCrudden. February 4th.
4,177. "Motor head-lights, and electric lamps therefor." A. B. Gibbons. February 4th.
4,178. "Registering telephone calls." E. H. Kinnard. February 4th.
4,179. "Talking machines, &c." C. J. Barnett. February 4th.
4,180. "Telephonic apparatus." H. Edmunds. February 4th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1914.

8,327. "Control apparatus for multiple-speed gear." Payne and Bristol Tramways & Carriage Co., Ltd. April 2nd, 1914.
17,036. "Electric gasfilled glow discharge lamps." Lederer. July 19th, 1913.
17,646. "Electric gasfilled glow discharge lamps." Lederer. July 25th, 1913. (Addition to 17,036, 1914.)

1916.

16,009. "Speed regulation of electric induction motors." British Thomson-Houston Co., Ltd. (General Electric Co.). November 20th, 1916. (156,813.)

1917.

16,855. "Automatic and distant control of aircraft or other dirigible bodies." J. H. Hammond. November 15th, 1917. (156,818.)

1919.

14,327. "Railway signalling and collision prevention apparatus." W. Wright, B. Weiss, P. A. Connolly, W. O. J. Philips, and L. Langford. June 6th, 1919. (156,830.)
14,476. "Thermostats." J. E. Gee. June 6th, 1919. (156,831.)
16,232. "Electric welding." L. J. Steele, H. Martin, and A. E. McCarthy. June 27th, 1919. (156,836.)
17,831. "Method for the heating of material or the performance of chemical processes in electrical furnaces, together with apparatus intended therefor." Aktiebolaget Kvafveindustri. April 12th, 1919. (141,656.)
22,725. "Electric heating device applicable for use in connection with cooking utensils and the like." S. L. R. Price. September 16th, 1919. (156,862.)
24,105. "Alternating current dynamo electric machines." British Thomson-Houston Co., Ltd., and H. W. Taylor. October 2nd, 1919. (156,868.)
24,403. "Transmitting apparatus for use in wireless telegraphy and telephony." J. B. Bolitho. October 6th, 1919. (156,876.)
24,724. "Electrical seam welding machines." E. Schroder. May 30th, 1918. (133,700.)
26,126. "Lift-gate switches and locks." Igranic Electric Co., Ltd., and A. H. Mackley. October 24th, 1919. (156,936.)
26,542. "Portable magneto meter." T. L. Galloway. October 29th, 1919. (156,944.)
26,611. "Electric meters." G. A. Cheetham and Metropolitan-Vickers Electrical Co., Ltd. October 29th, 1919. (156,945.)
27,086. "Electric bells." J. C. Wrighton and Edison Swan Electric Co., Ltd. November 4th, 1919. (156,954.)
27,930. "Mine exploding devices." R. Barthelemy. May 19th, 1919. (143,488.)
28,088. "Devices for exploding mines." R. Barthelemy. November 12th, 1919. (Addition to 143,488.) (156,961.)

1920.

2,304. "Process and apparatus for the electrical transference of designs in the textile arts." E. C. R. Marks (Oesterreichische Siemens-Schuckertwerke and Regal-Patente Ges. January 24th, 1920. ((156,995.)
4,676. "Electric lamp mountings." L. T. Dixon. February 16th, 1920. (157,000.)
7,542. "Switch and fuse contacts." J. F. Watson and Callender's Cable and Construction Co., Ltd. March 13th, 1920. (157,011.)
9,651. "Process of improving the magnetic qualities of magnetisable material." Metropolitan-Vickers Electrical Co., Ltd. April 4th, 1919. (141,348.)
9,686. "Electric furnaces." E. Assie. August 9th, 1917. (141,352.)
12,053. "Telephone systems." Western Electric Co., Ltd. May 21st, 1919. (143,498.)
12,137. "Stiffeners or strengthenings for wooden posts, poles, and similar objects which are buried in the ground and liable to become defective." E. Schultz. October 10th, 1919. (152,629.)
14,673. "Rectification of high-tension generating currents." Soc. Anon. des Etablissements H. Pilon. April 9th, 1919. (143,929.)
15,727. "Telephone transmitter." Western Electric Co., Ltd. June 22nd, 1914. (144,698.)
19,849. "Electric arc lamps for searchlights or projectors." Siemens-Schuckertwerke Ges. April 3rd, 1917. (147,804.)
23,552. "Arc lamps." P. R. Jackson (Sperry Gyroscope Co.). July 11th, 1919. (Divided application on 152,411.) (157,039.)
24,546. "Electric incandescent arc devices." British Thomson-Houston Co., Ltd. (General Electric Co.). March 4th, 1916. (Divided application on 152,681.) (157,041.)
25,248. "Electric contact devices." C. C. Farmer. December 10th, 1919. (155,230.)
28,085. "Electrical regulator systems." Metropolitan-Vickers Electrical Co., Ltd. October 2nd, 1919. (151,992.)